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FEEDS SUPPLEMENTARY TO CORN FOR FATTENING STEERS.

By HERBERT W. MUMFORD, B. S., Professor of Animal Husbandry,
College of Agriculture, and Chief in Animal Husbandry,
Agricultural Experiment Station.

Introduction.

In considering feeds supplementary to corn for fattening steers, corn and its stover are looked upon as the basis of the ration; feeds other than corn and its stover or stalks added to the ration are designated as "feeds supplementary to corn." Supplementary feeds may be such roughage as timothy, clover, alfalfa, or cow pea hay or they may be concentrates such as linseed oil meal, cotton seed meal, wheat bran, and blood meal.

The time has passed when all kinds of cattle carelessly fed will return a profit to the feeder. Economical production of beef means the production of the greatest number of pounds of beef on cattle possessing quality enough to sell in the open market at prices which return to the feeder a maximum profit after having taken into account the purchase price and the cost of feed. It is needless to say that it is not always the feeder who tops the market who secures the greatest profit; nor is it necessarily the one who has secured the greatest gains on his cattle.

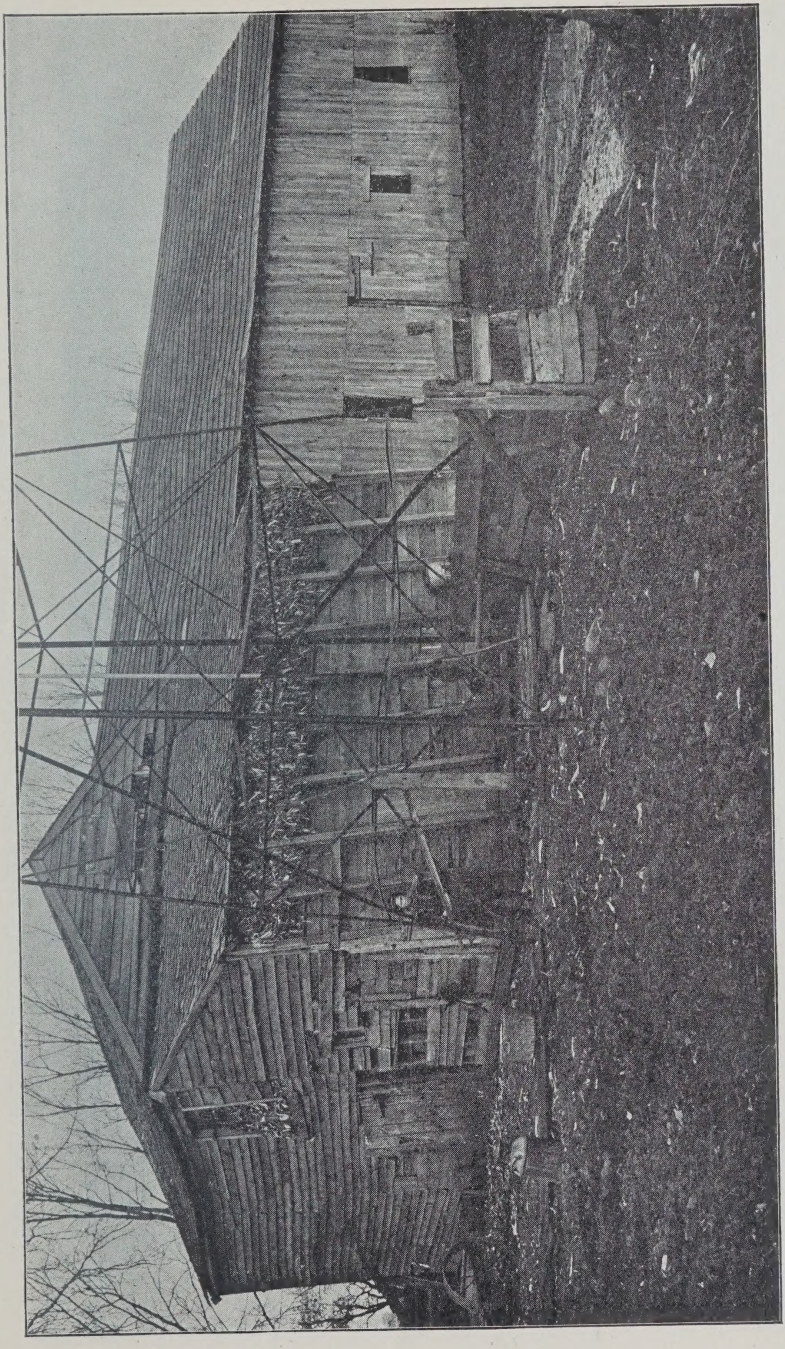
The business of beef making is daily becoming more complex. It involves right buying, correct methods of feeding, and judgment as to how fully it pays to finish the various grades of cattle ; or in other words, it involves intelligent marketing.

OBJECT OF THE EXPERIMENT.

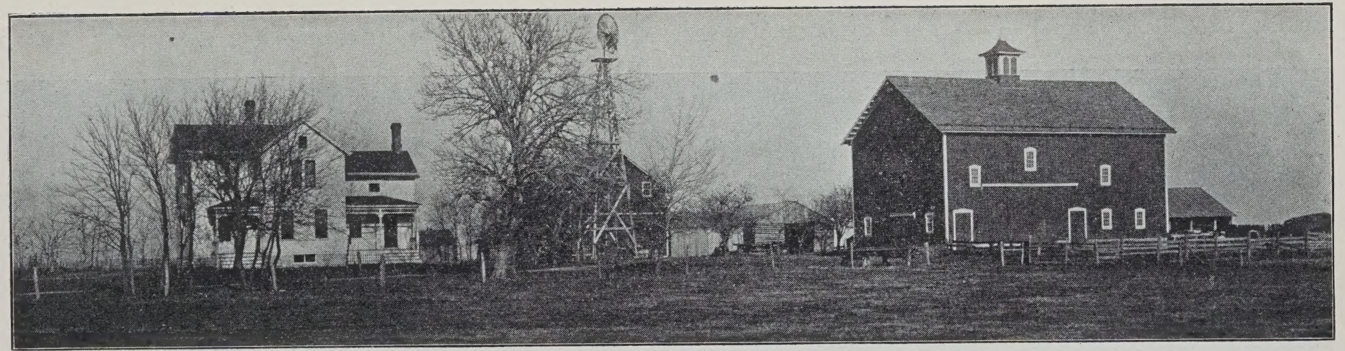
This experiment involves an investigation of methods of feeding and marketing. Cattle feeding experiments thus far strongly indicate that corn should be supplemented with some nitrogenous food-stuff ; it may be thus supplemented by either roughage or concentrates. Investigators have given much attention to the subject of supplementing corn with various concentrated nitrogenous food-stuffs; while relatively few have considered the possibility of supplementing corn with roughage in such a way as to secure the same advantageous results as when corn is supplemented with a concentrate such as oil meal.

The Experiment Station of the University of Illinois is making a thorough study of this question. The results of this experiment reported in this bulletin will tend to emphasize the importance of this subject. We proceed on the principle that the farm on which the cattle are fed should produce as far as possible the food-stuffs required; hence, these investigations will consider the results to be secured from the feeding of such varieties of hay and other roughage as can be grown in the corn belt, to determine what available roughage or combination will best supplement corn and require the least cash outlay for concentrates.

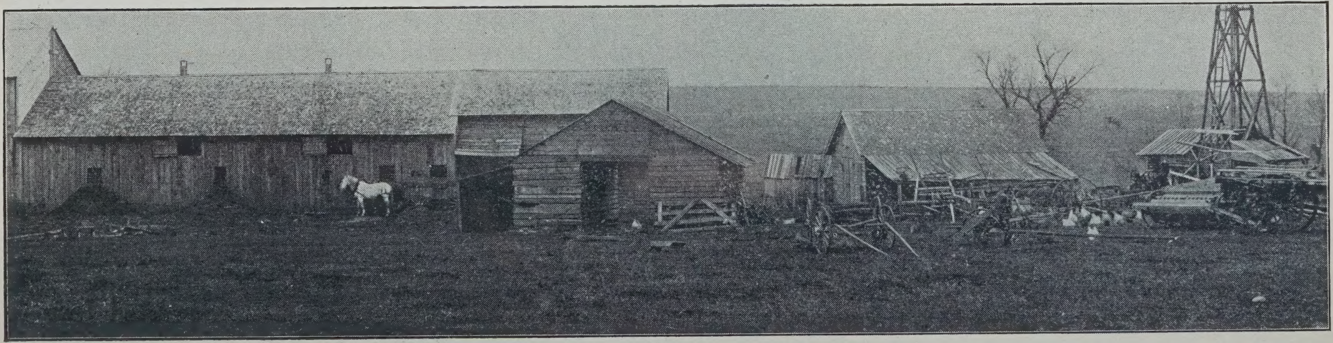
Whatever may be the prevailing opinion among cattle feeders as to the value of corn and clover hay as an ideal ration for fattening steers, the most progressive feeders and breeders and those who send the best finished cattle to the market agree that the highest finish in a given time can not be secured by adhering strictly to this ration throughout the feeding period. They believe that the effectiveness of such a ration, so far as producing a quick and complete finish is concerned is materially enhanced by the addition of some highly nitrogeneous concentrate either throughout or toward the end of the feeding period. One of the objects of this experiment was to secure additional data on this important subject.



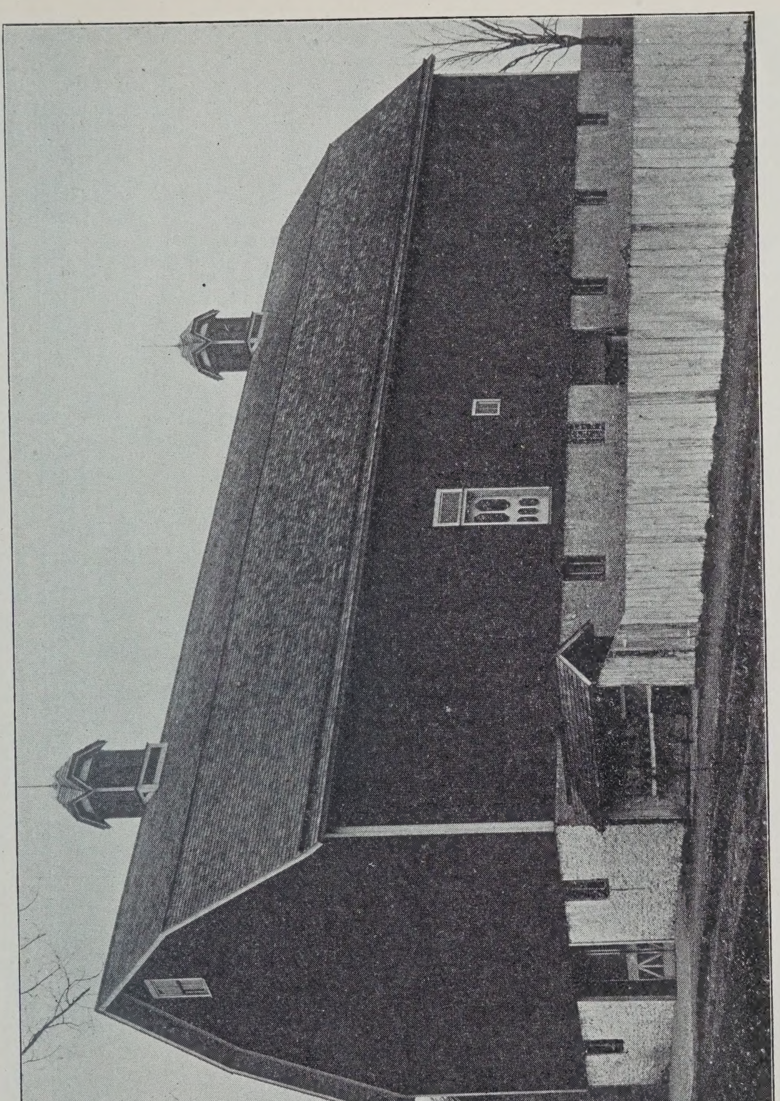
CUT 13. PORTION OF BARN ON RIGHT IS A STABLE FOR 36 COWS. NO PROVISION FOR LIGHT OR VENTILATION; OPENINGS SHOWN ARE COVERED WITH BOARDS IN WINTER. MUD HOLE IN YARD; MARKS ON BARN SHOW WHERE MANURE HAS BEEN PILED.



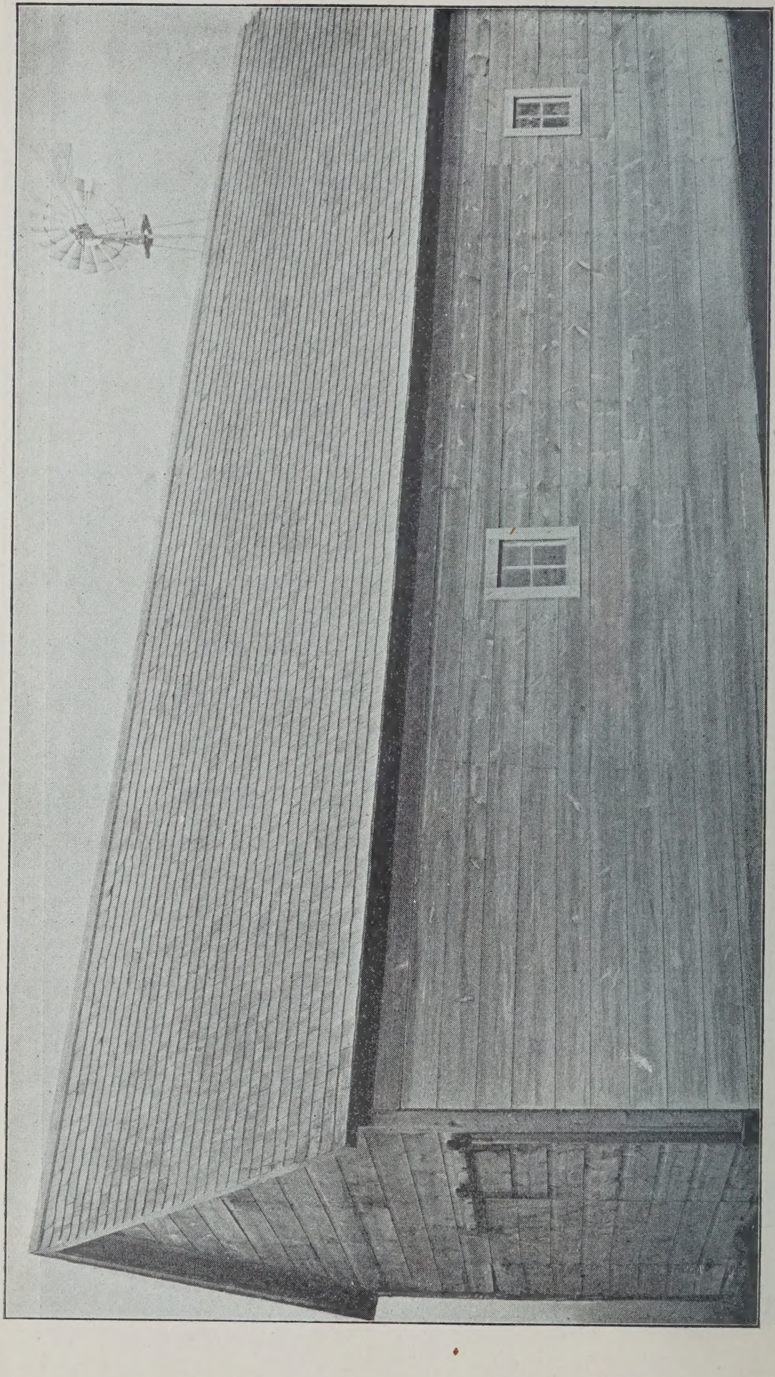
Cut 14. Contrast with Cut 15.



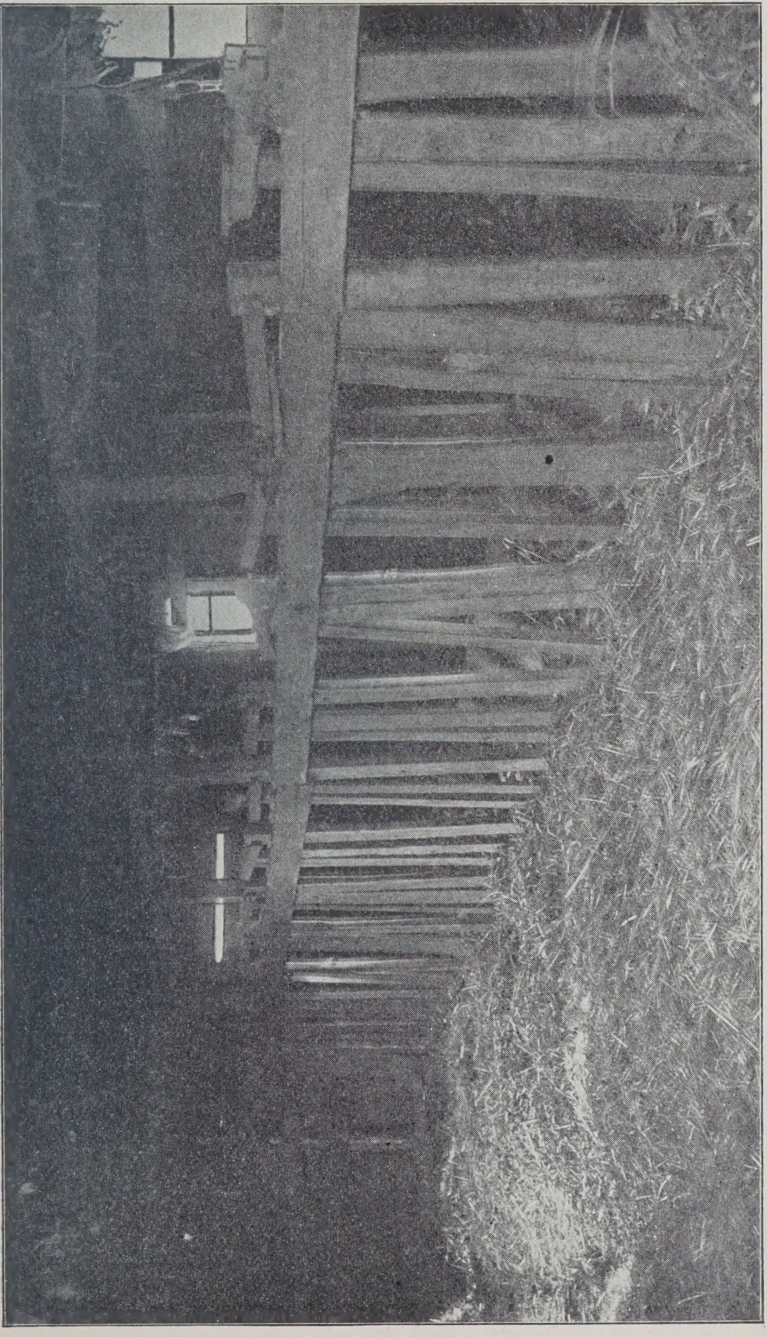
Cut. 15. Milk is produced here for Direct Consumption from Dairy of 40 Cows. Barn has Little Provision for Light, and Manure is Left in Piles at the Openings, Contaminating the Air and Tainting the Milk.



CUT 16. THIS DAIRY BARN, FINE MILK HOUSE COSTING $1000, AND GOOD FARM OF 186 ACRES HAVE BEEN PAID FOR FROM THE SALE OF MILK.



Cut 17. A Good Cheap Stable for 14 Cows. This Stable 16x42 feet was Built in 1897. The Material Cost $120, and the Work was Done by the Owner. Interior Shown in Cut 18.



Cut 18. Interior of Cut 17. All this Cheap Cow Stable Needs to make it Sanitary is a Tight Floor Overhead, the Interior Whitewashed, Ventilators, and More Windows, all of which could be done at an Expense not to Exceed $30.

Exterior and interior views of a cheap stable are shown in cuts 17 and 18. This stable is 16x42 feet with ten foot posts and will hold 14 cows. It was built in 1897, the material costing $120.00. This stable was built by the owner; had the work been done by a carpenter the expense would not have exceeded $50.00 making the total cost $170.00.

What this stable needs to make it sanitary is a tight floor overhead, ventilators, five times the amount of light and the interior whitewashed, all of which could be done at an expense not to exceed $30.00. Making the total cost of a sanitary stable for fourteen cows $200.00.

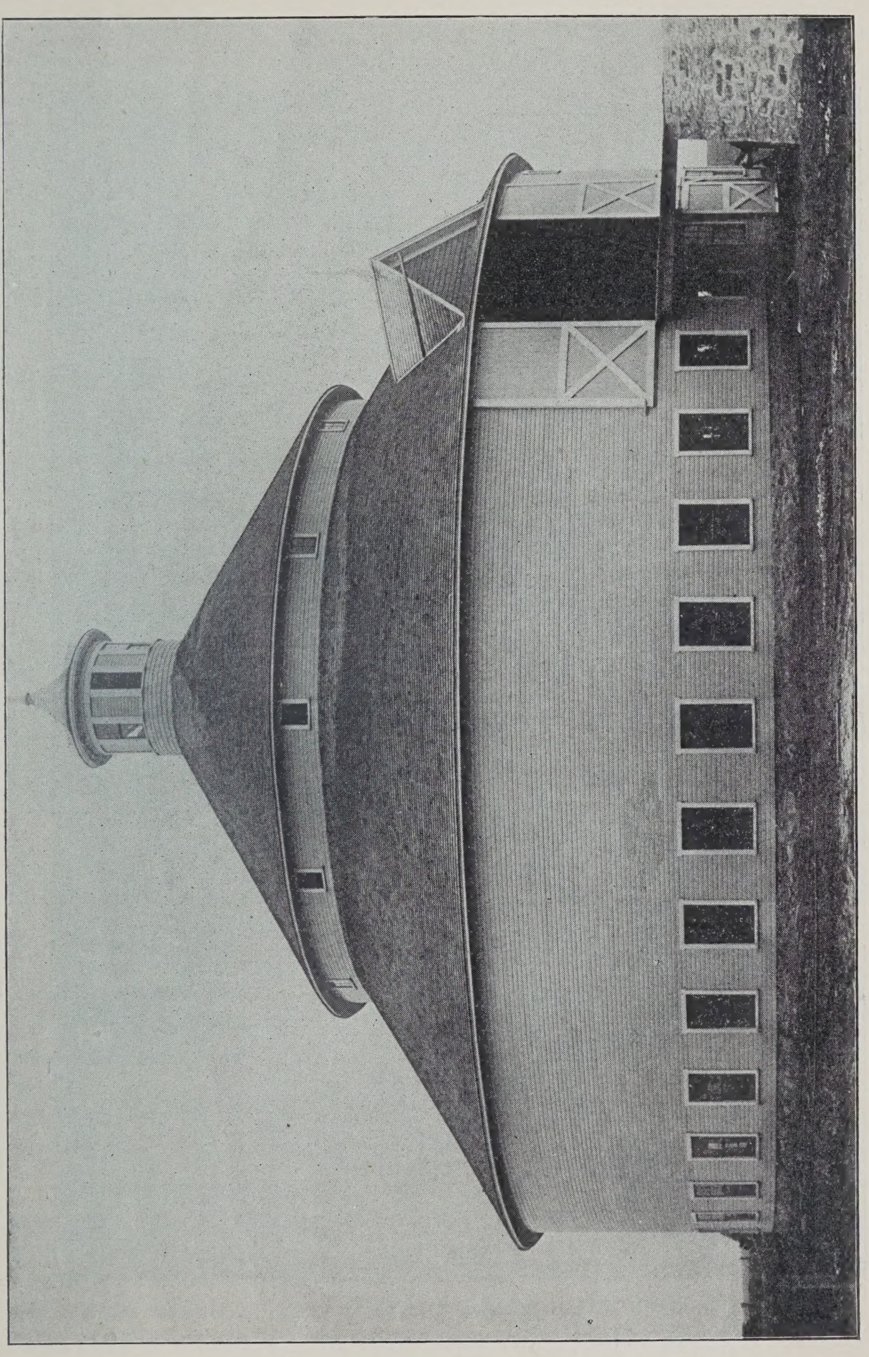
A stable for a double row of cows could be built cheaper in proportion; for it would not be necessary to have it twice as wide, the same feed alley answering for both rows. If more loft room is desired for storage of rough feed, this could be provided by putting the roof higher at but slight additional expense.

Two things almost universally lacking, or at least inadequately supplied, in dairy barns are light and pure air. These are easily obtained and although absolutely essential to the best health of the herd and the economic production of clean milk they are rarely appreciated.

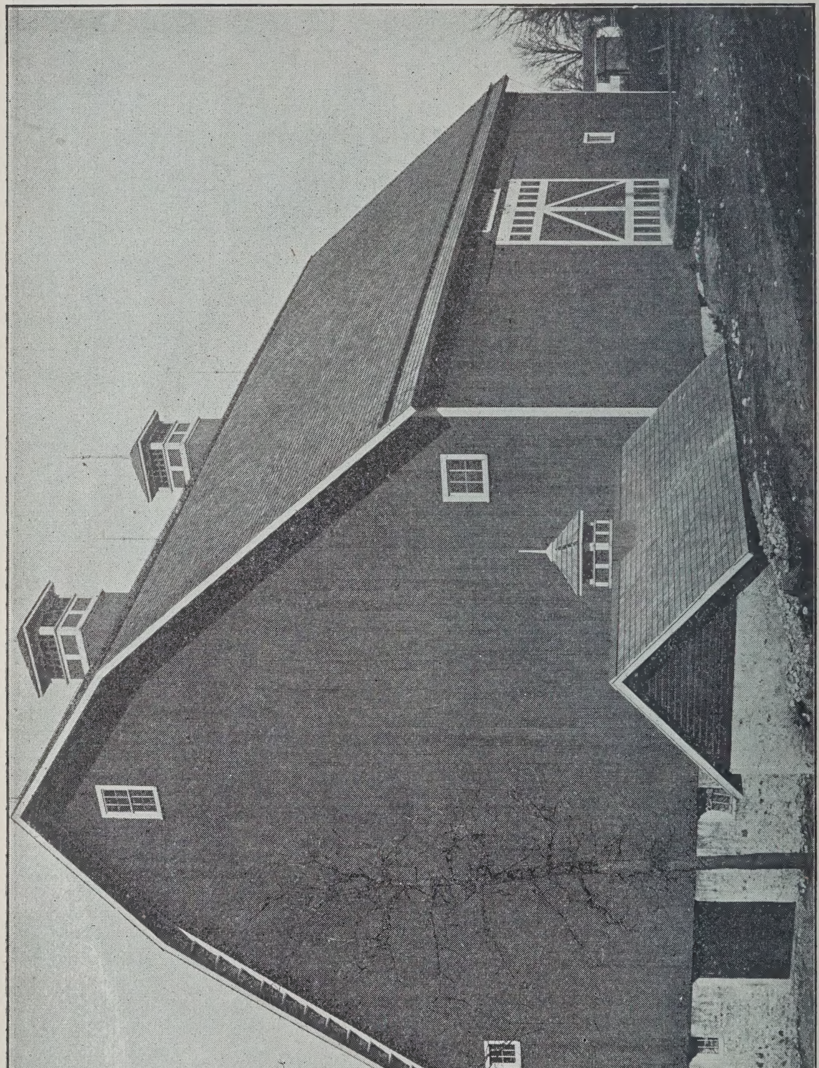
Cuts 12 and 19 show dairy barns containing sufficient windows. These are in striking contrast with others shown in this bulletin and seen throughout the State. If a barn is already built and has insufficient light more windows can easily be provided. There should be from three fourths to one and one half square feet of glass for every linear foot of outside wall in a dairy barn.

Many barns are not provided with any system of ventilation whatever, as but few dairymen realize that pure air is just as essential to the economic production of untainted milk as is the feed a cow consumes. Digestion and assimilation, like the burning of coal in a stove, are processes of combustion. The stove may be filled with coal but if the drafts are kept tightly closed the coal will not burn, as sufficient oxygen is not provided. Neither can a cow's feed be properly digested and assimilated without an abundance of oxygen, and unless this is supplied a great waste of food as well as impaired health of the cow will result.

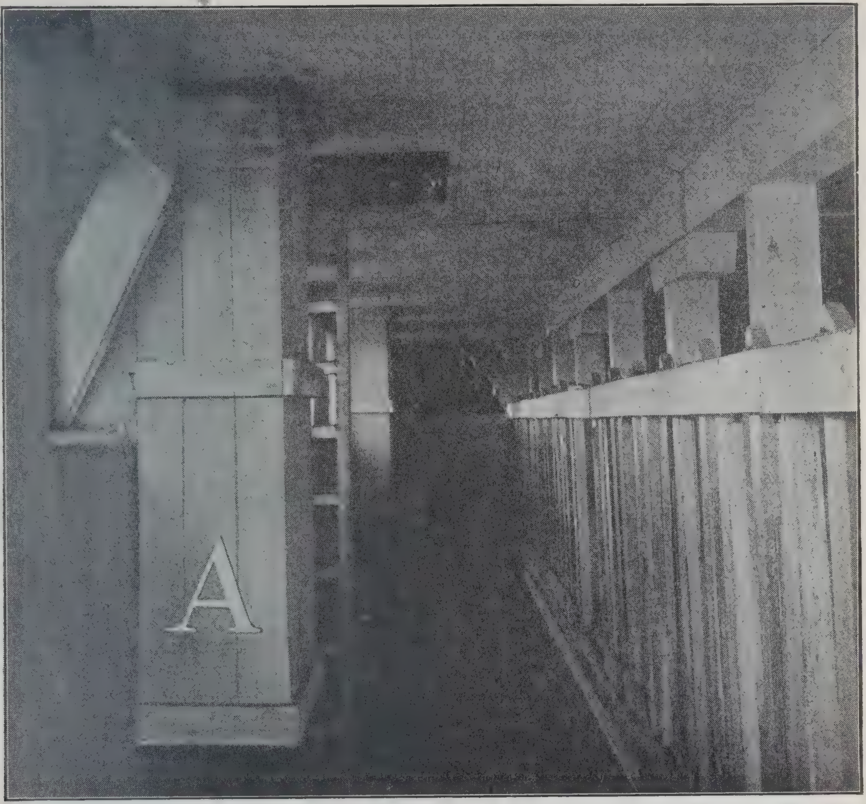
Much has been said about the number of cubic feet of air space that should be allowed for a cow, but this is of little consequence in comparison with the more important question of ventilation, or change of air. In order not to get a greater degree of impurity in the air than is permissible with good results each cow should be supplied with 3,540 cubic feet of air per hour. The size of the



Cut 19. A Circular Dairy Barn Admirably Lighted and Having the King System of Ventilation.



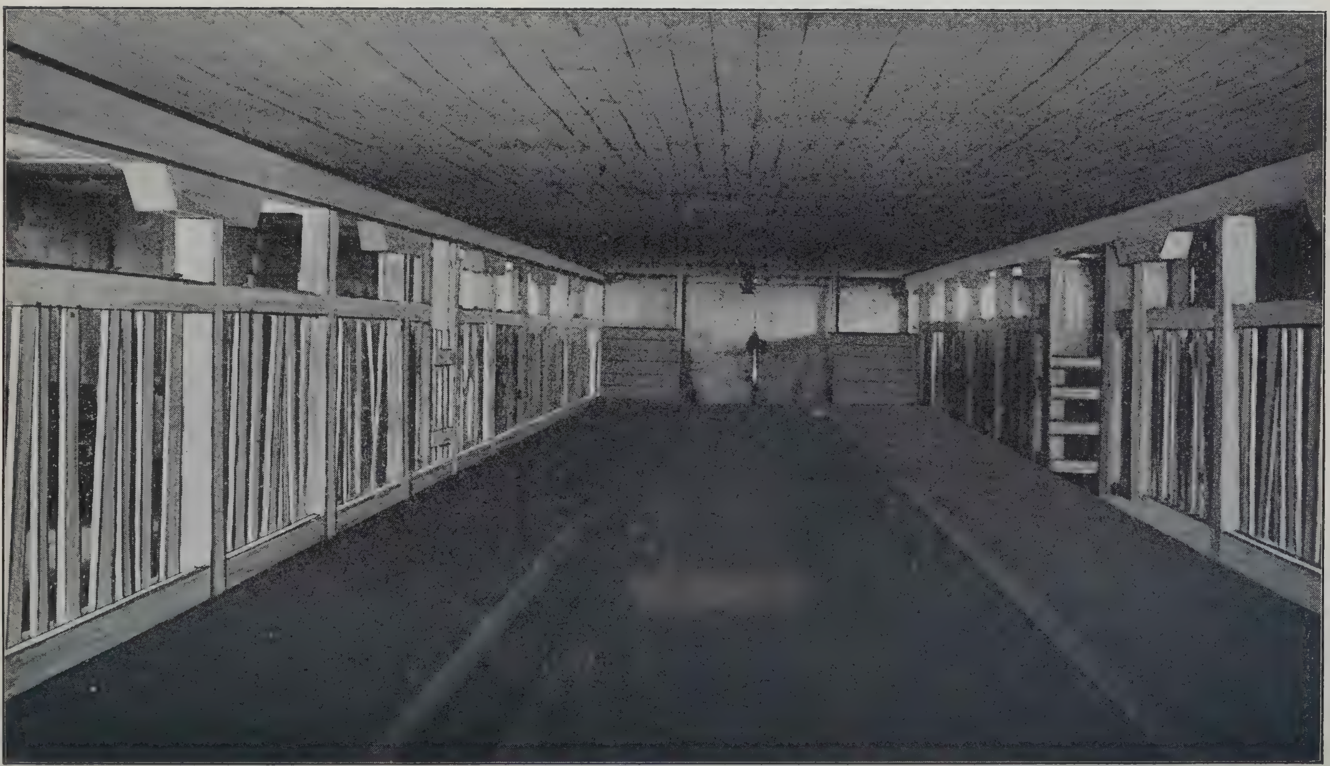
Cut 20. A Dairy Barn and Milk House Adjacent. As Expensive a Barn as this is Not Essential to the Production of Clean Milk but this Shows what the Dairy Business will Support as the Farm has been a Strictly Dairy Farm for Thirty Years.



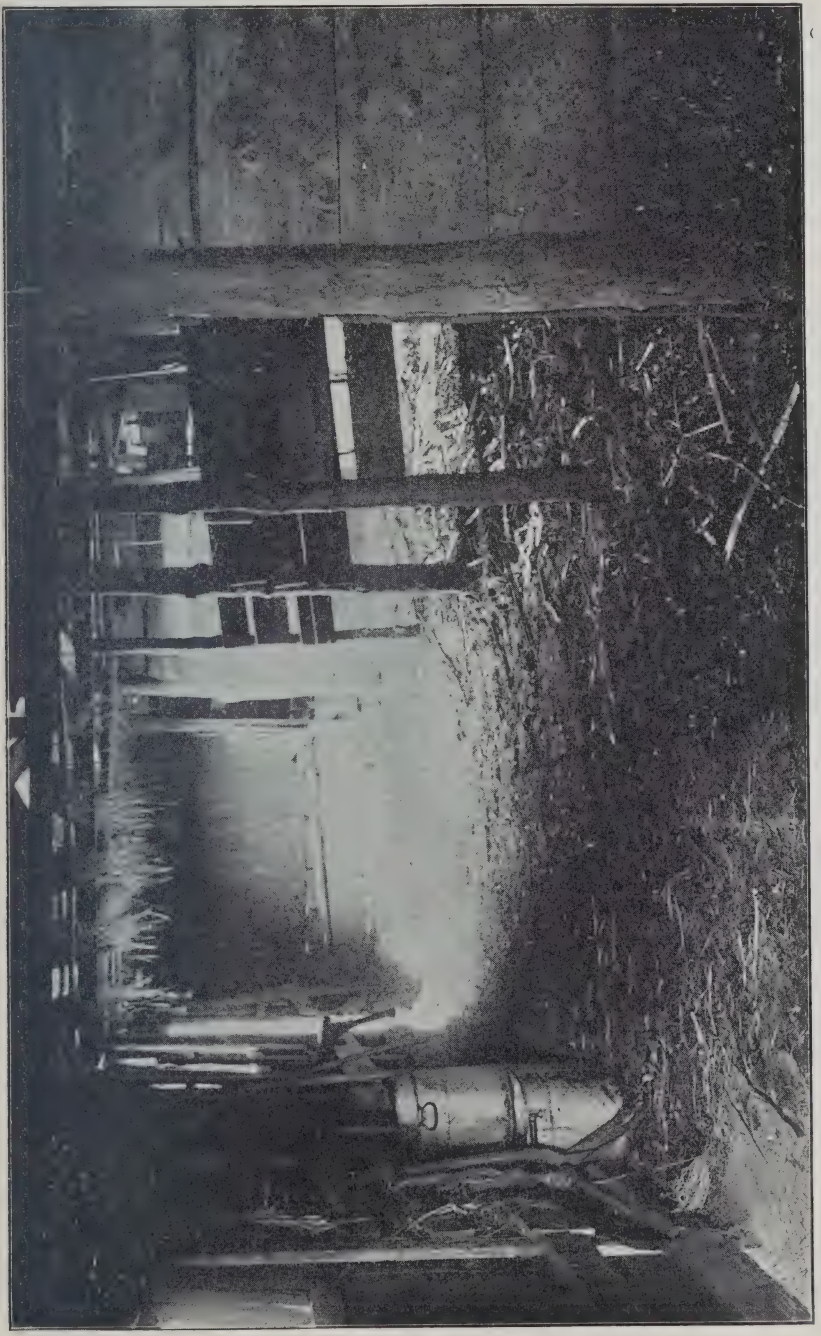
Cut 21. The King System of Ventilation in Dairy Barn, shown in Cut 20. Fresh Air is Carried between Joists Overhead to Center of Barn; Foul Air drawn out from near Floor by Four Large Ventilators carried above Roof, causing a Continuous Change of Air Without Creating a Draft on the Cows. Ventilator shown at "A."

ventilating flues to be provided will depend upon the number of cows in the stable. About four square feet is a good size for a ventilating flue and if so constructed as to cause the air to travel 300 feet a minute this will furnish ventilation for twenty cows. Two flues this size would be sufficient for forty cows and five would be required for one hundred cows.

To be sanitary a dairy barn should be whitewashed at least once a year. An interior like the one shown in cut 23, with a few boards laid overhead at irregular intervals, with hay hanging through and with the sides in no better condition, cannot be properly whitewashed. The ceiling should be tight, excluding all dust and chaff from above, and sides smooth, thus affording a firm surface to which the whitewash can cling.



CUT 22. A SANITARY COW STABLE; FLOOR KEPT CLEAN, CEILED OVERHEAD, AND WHOLE INTERIOR WHITEWASHED.



CUT 23. WHILE THIS STABLE IS IN BAD CONDITION IT COULD BE MADE SANITARY AT BUT SLIGHT EXPENSE BY CEILING THE INTERIOR TO MAKE A SMOOTH, FIRM SURFACE, WHITEWASHING SAME, PUTTING IN WINDOWS AND VENTILATORS, AND KEEPING CLEAN.

It is not necessary to ceil the barn with surfaced lumber, in fact, the whitewash will adhere better if the surface is not too smooth. The boards must, however, be reasonably clean before the whitewash is applied, otherwise it will be of little use for it will soon shell off with the filth; and besides this, filth simply covered is not removed.

Whitewash is one of the cheapest disinfectants and can be easily and rapidly applied with a spray pump. It must be carefully strained before using in the pump as any lumps will clog the spray nozzle.

A cement floor is the most sanitary for a cow stable and when put down it should be left rough under the float to prevent the cows from slipping. An objection often made to cement floors is that they are cold in winter, but as the temperature in a dairy barn should never get below 40° F. this objection is largely overcome, if the cows are properly bedded. When a plank floor is used it must be renewed as fast as it wears or rots out.

It is of the utmost importance in keeping cows clean that the platform on which they stand be of the proper length. If it is too short the cows cannot lie down comfortably and if too long the droppings will fall on the rear of the platform and the cows will become soiled when lying down. As cows vary in length the platform should be longer, from the manger to the gutter, at one end of the barn and gradually taper to six or eight inches shorter at the other end. When large herds are kept the platform on one side of the barn may be longer than on the other side and the cows arranged accordingly. A still better arrangement is some form of movable manger so that the length of the platform can be adjusted to suit each individual cow. With this arrangement all can be lined up on the gutter, which will be a great help in keeping the cows clean.

THE CARE OF MILK.

As soon as it is drawn milk should be removed from the stable to a place provided for the purpose and there aerated and cooled to 50° or 60° F. This should be done either by setting the cans into a tank of cold water and stirring occasionally or by passing the milk over a cooler. The latter method is to be preferred if the cooling can be done in a pure atmosphere free from dust. It is of great importance to have a small milk house or some clean room away from the odors of the stable in which to care for milk. A good cheap milk house is shown in cut 37.

The sooner milk is thoroughly cooled after it is drawn, and the lower the temperature to which it is taken, the better. Bacteria that get into milk during the process of milking develop very rapidly so long as milk remains at about the temperature at which it was drawn, but as soon as cooled to 60° they develop slowly, and if cooled to 40° their action is almost entirely stopped. Milk cooled to this temperature as soon as drawn and held there will remain sweet and in good condition much longer than if cooled to only 70° or 75°.

CUT 24. DAIRY UTENSILS IN THE BATTERED CONDITION OF CAN ON LEFT, AND WITH TIN OFF IN MANY PLACES INSIDE, CANNOT BE KEPT CLEAN AND SHOULD BE DISCARDED.

CARE OF DAIRY UTENSILS.

One of the first essentials in keeping dairy utensils clean is to have a smooth surface. This fact should be kept in mind when purchasing, and if all seams are not flushed smooth with solder this should be done. As soon as the tin is worn off on the inside, exposing the iron, the utensils should be discarded, for they cannot be properly cleaned when in this condition. All utensils should be washed as soon as possible after using since the longer the milk remains on them the harder they will be to clean. They should first be rinsed with lukewarm water to remove the milk, then washed with hot water and soap or some alkali, and scalded with boiling water, or with steam if it is available. Cans should never be tightly closed when not in use and should be placed on a rack in an inverted position so that dust cannot blow into them. If possible they should be placed where the sun will shine on them as that will do much toward keeping them pure and sweet.

Bottles used to deliver milk for direct consumption must be taken to the dairy after each using and thoroughly washed and sterilized to kill all disease germs. If this is not done disease may be carried from one house to another by means of the bottles. The practice some dairymen have of bottling milk in the wagon on the route, using bottles collected from houses just visited, cannot be too strongly condemned and should be prohibited by law.

THE FEED OF COWS.

Sudden changes of feed should be avoided, especially if very marked, as in changing from dry to green feed. Special care is required when cows are put on pasture in the spring and when first turned on rye or clover. Only a small quantity of green feed should be given at first, the amount being increased as from day to day the dry feed is reduced. If care is not exercised at such times the cow's system is likely to become deranged and the milk will then have a peculiar, disagreeable odor, but if this method is followed the system gradually becomes adjusted to the new conditions and no bad results follow.

When feeding turnips or cabbage the difficulty is frequently experienced of having disagreeable odors in the milk. This difficulty may be largely if not entirely avoided by feeding after milking rather than just before, as the peculiar odor produced by these feeds will then leave the cow's system before the next milking time.

CREAMERY.

The location of a creamery should be such as to insure good drainage. The ground surrounding it should be seeded and the road graveled that so far as posssble dust may be prevented from blowing into the building. Cleanliness at a creamery should prevail without and within, not alone because neatness is essential to the production of the highest grade of butter but also because of its effect upon the patrons. Every creamery should be a nucleus for high standards in dairying. The creamery operator cannot expect his patrons to bring clean milk properly cooled and cared for if the creamery is in a neglected condition, as it would be evident that under such circumstances all care on their part would be lost.

Every creamery, cheese factory, dairy, or milk depot should have the floor, and the walls to the height of at least three feet, of some impervious material. Cement makes the best and cheapest floor when properly laid. Faulty cement work can only be remedied by replacing with another floor.

To carry off more readily the water, the floor should pitch to the gutter. The distance to the gutter should not be more than twelve feet; if it is greater the water will not be carried off rapidly enough. The gutter should pitch to the sewer which should be well trapped and constructed of glazed sewer tile for a distance of at least two hundred feet from the building. At the end of the glazed tile a silt basin should be built of brick, stone, or cement, and ten or twelve inch porous tile laid from this into some well drained ground. From the large tile small laterals should be laid; the number and length needed will depend upon the amount of water to be disposed of and the character of the ground in which the system is laid. If the system is put in and found to be inadequate it can easily be extended by putting in more laterals or making them longer.

If the ground is naturally wet the system can be made much more efficient by laying drain tile among these to drain the ground, never getting closer than ten feet to the porous tile carrying the sewage. Much of the solid material in the sewage may be prevented from getting into the porous tile by frequently cleaning the silt basin.

Where no siphon is used between the silt basin and the porous tile there is a slow continuous flow of water into the tile which would seep out into the ground near the silt basin and deposit the solid material in the tile close to the basin. Where a siphon is used large quantities are carried over at one time, thus taking the solid material farther down into the porous tile. In time the tile nearest the silt basin will become filled up with solid material and may have to be cleaned out, but if large tile are used and the silt basin kept clean this system will prove satisfactory.

A CLEAN AND PROSPEROUS ILLINOIS CREAMERY.

The following twelve cuts show the interior of an Illinois creamery just as it appears every day when the regular work is in progress. No special cleaning was done before taking the photographs.

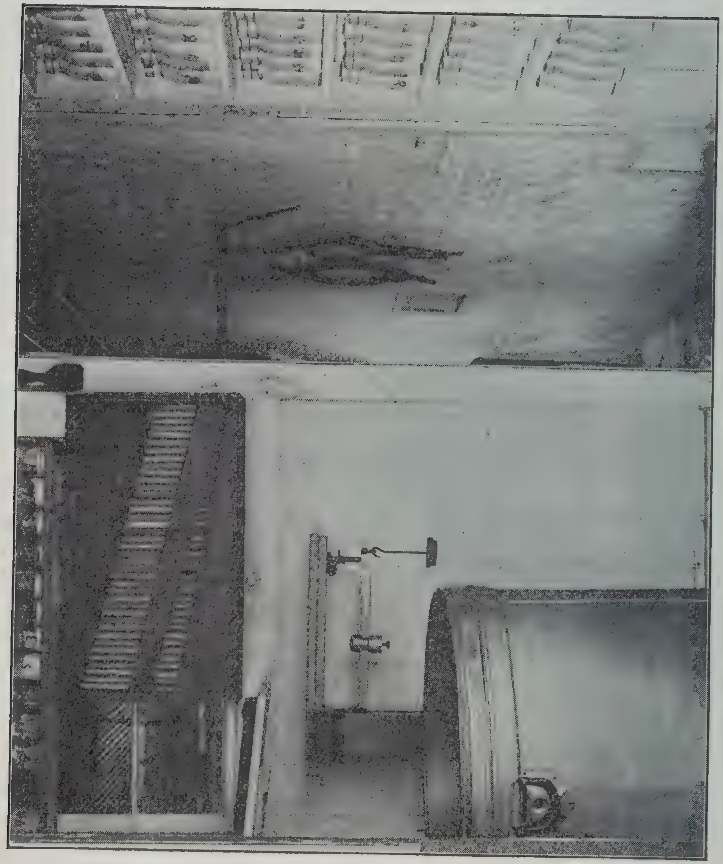
This sanitary creamery while not expensively built will remain in good condition for many years, as there is almost nothing about it to decay. The entire building, including partition walls, is of brick painted white. The building is provided with cement floor throughout and is neatly ceiled overhead. All win-

CUT 25. ENTRANCE TO A CLEAN, PROSPEROUS ILLINOIS CREAMERY; COUNTER ON RIGHT FOR RETAIL TRADE. THE FOLLOWING EIGHT CUTS ARE VIEWS IN THE SAME CREAMERY.

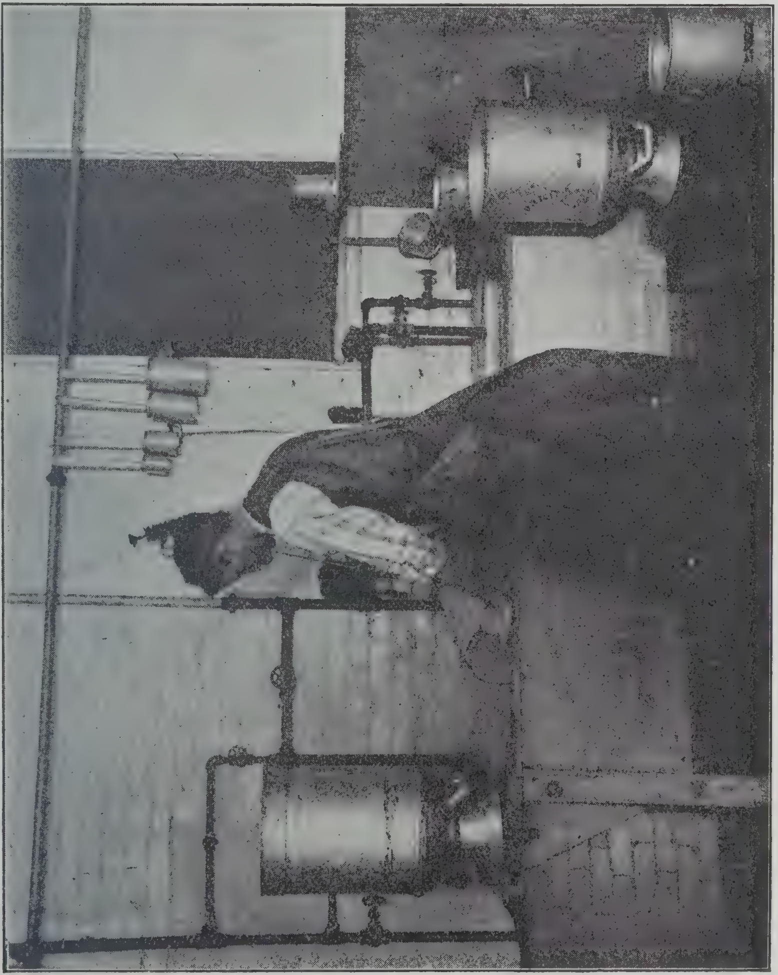
Cut 26. Office. Door Open into Entrance, Showing Counter, and Glass Doors in Refrigerator.

dows and doors are screened in summer and fly paper is freely used to catch the few flies that find entrance. Cement walks are provided to prevent tracking in during wet times as much as possible. There is a cement platform on which the wagons stand while receiving skim milk from the weigher; at the close of the day's run this platform is swept and flushed off with the hose, thus removing any skim milk that may have been spilled and keeping everything, even around the skim milk tank, sweet and clean.

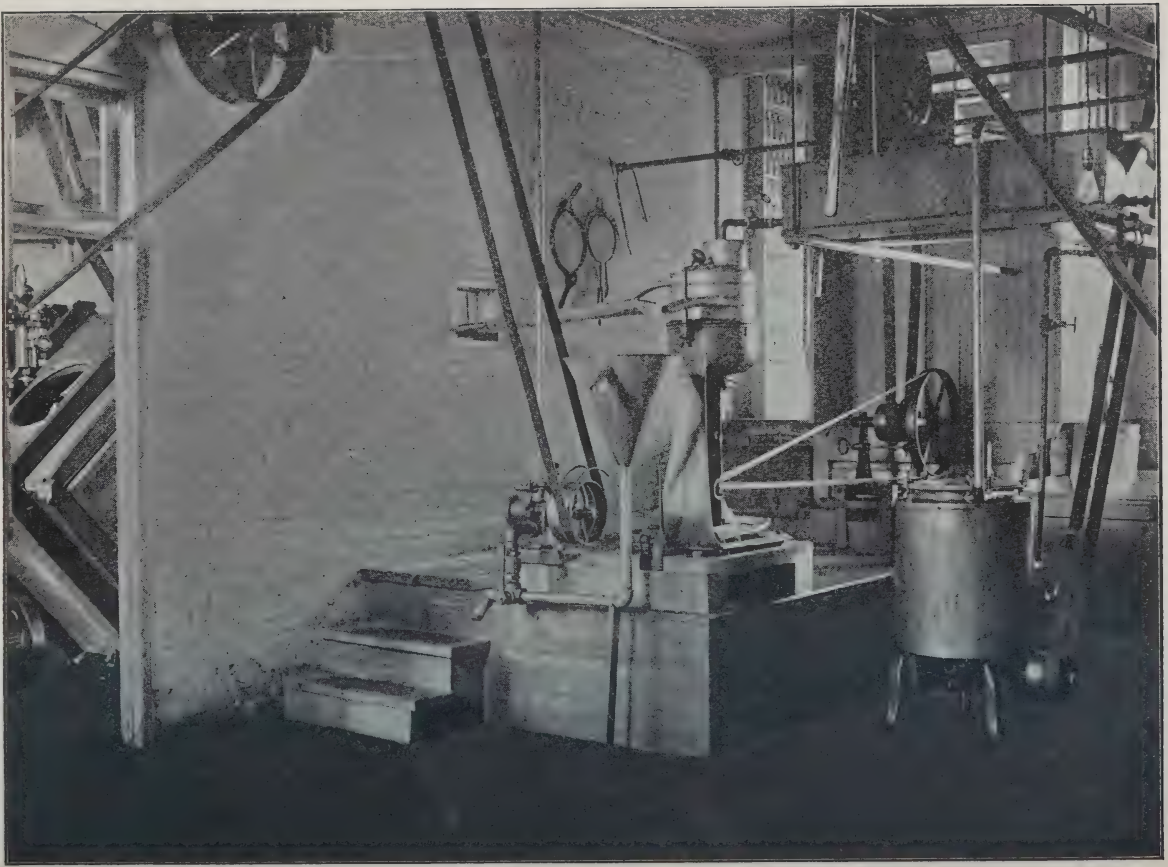
Not a can of milk is received at this creamery that the cover does not go to the nose of the man at the weigh-can before it is emptied and all milk that is not in good condition is returned.



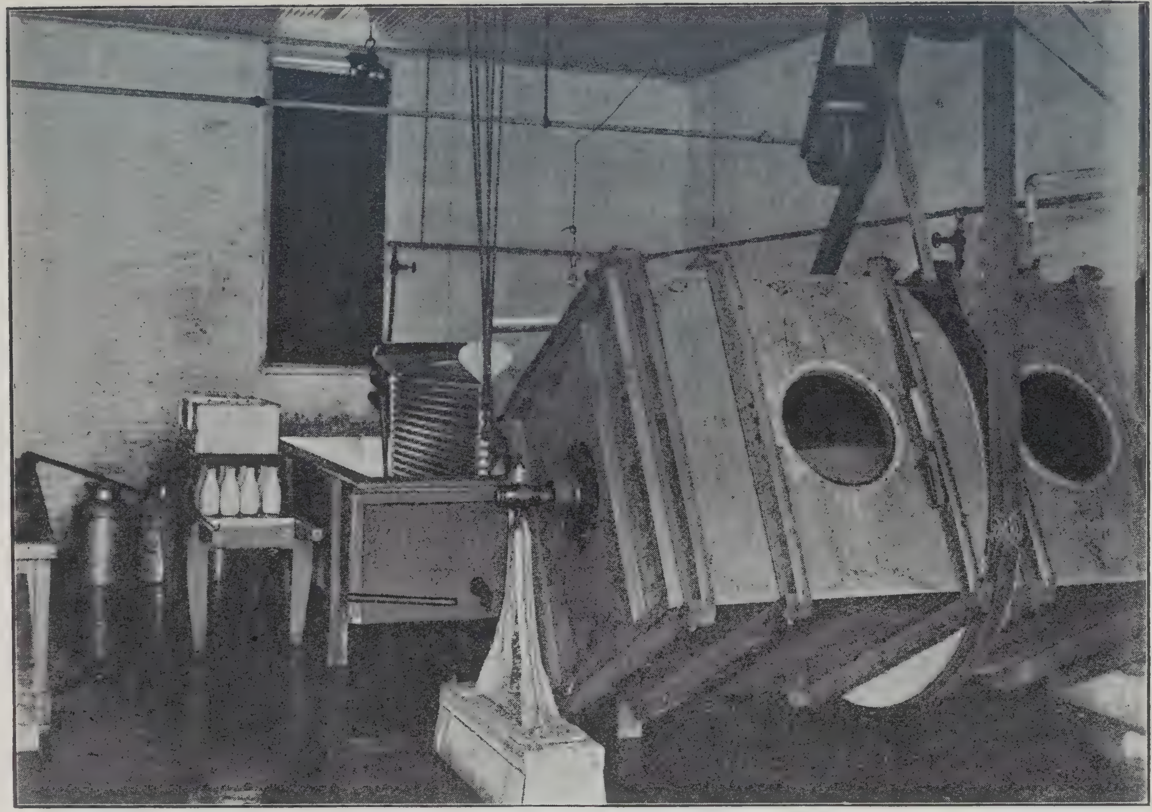
Cut 27, Receiving-room. Weigh-can, Scales, Sample Bottles, Floor, and Walls Kept Clean. Cleanliness here is of the Utmost Importance, as it is this portion of the Creamery or Factory that the Patrons see every day, and from it many fix their Standards.



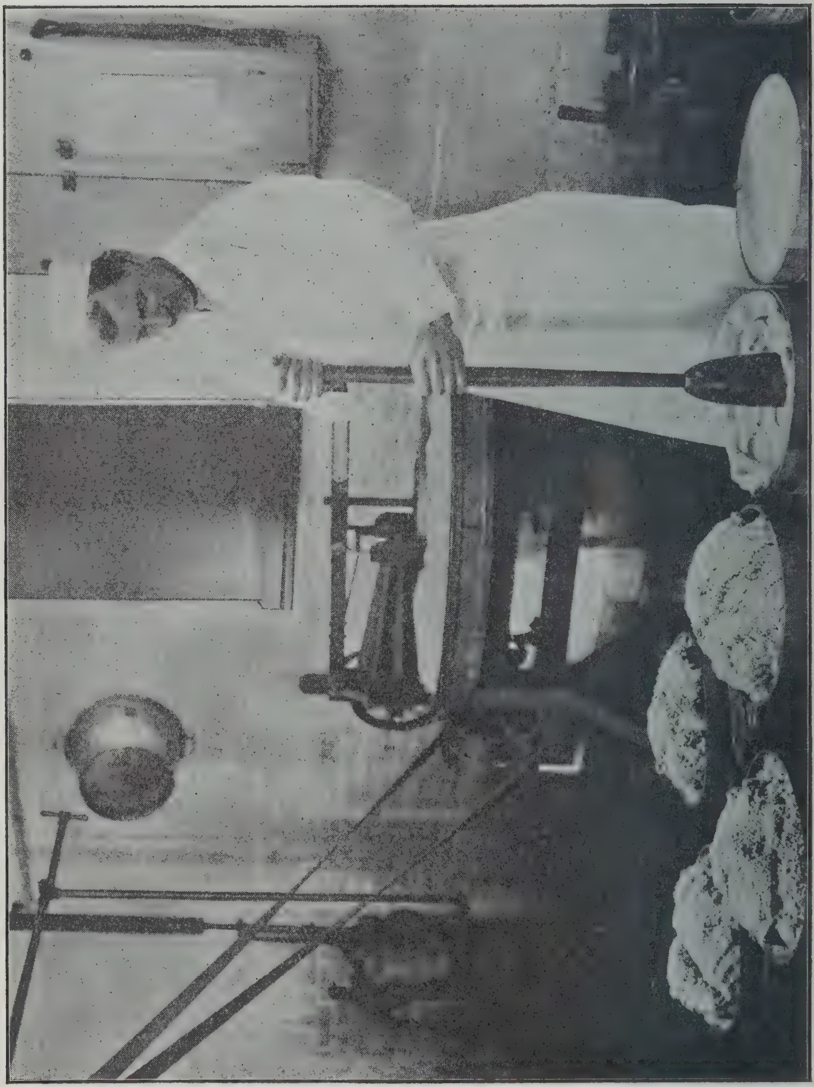
CUT 28. RINSING, WASHING, AND STERILIZING THE PATRONS' CANS AT THE CREAMERY.



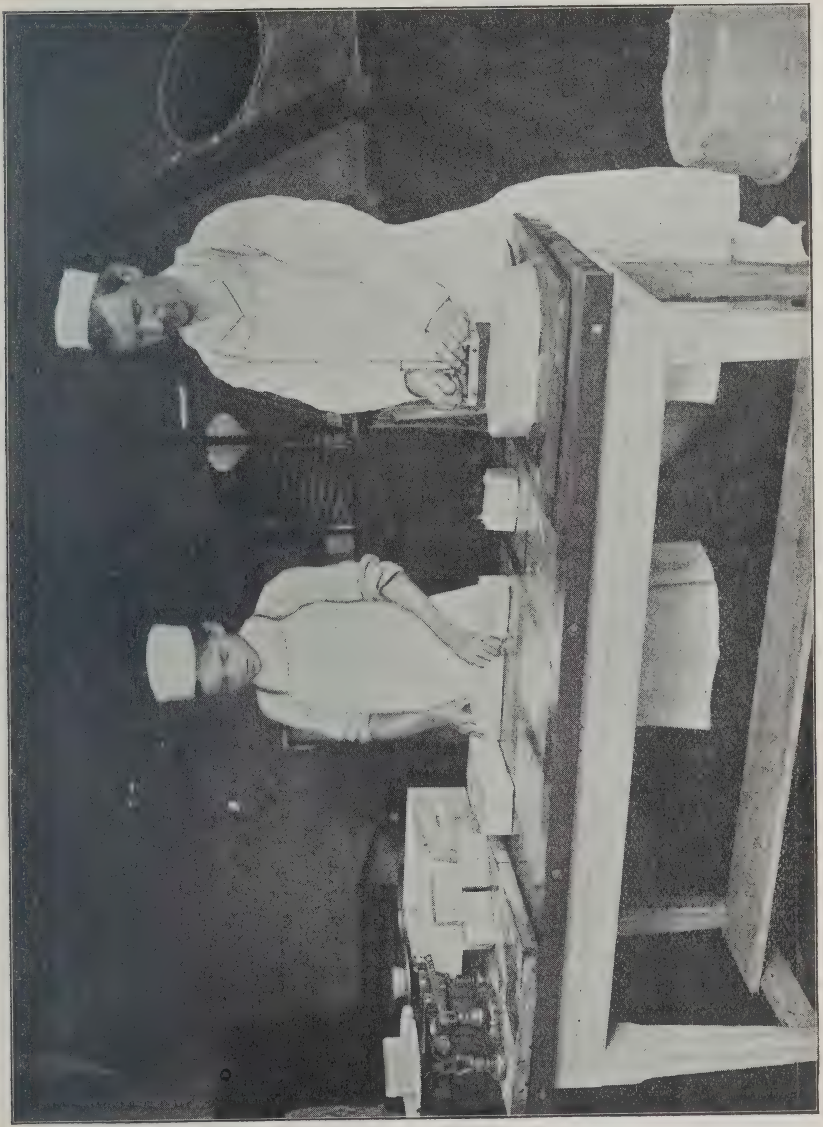
CUT 29. SEPARATING ROOM. FLOOR AND PLATFORM FOR SEPARATORS OF CEMENT; BRICK WALLS PAINTED WHITE; VATS, PASTEUR-



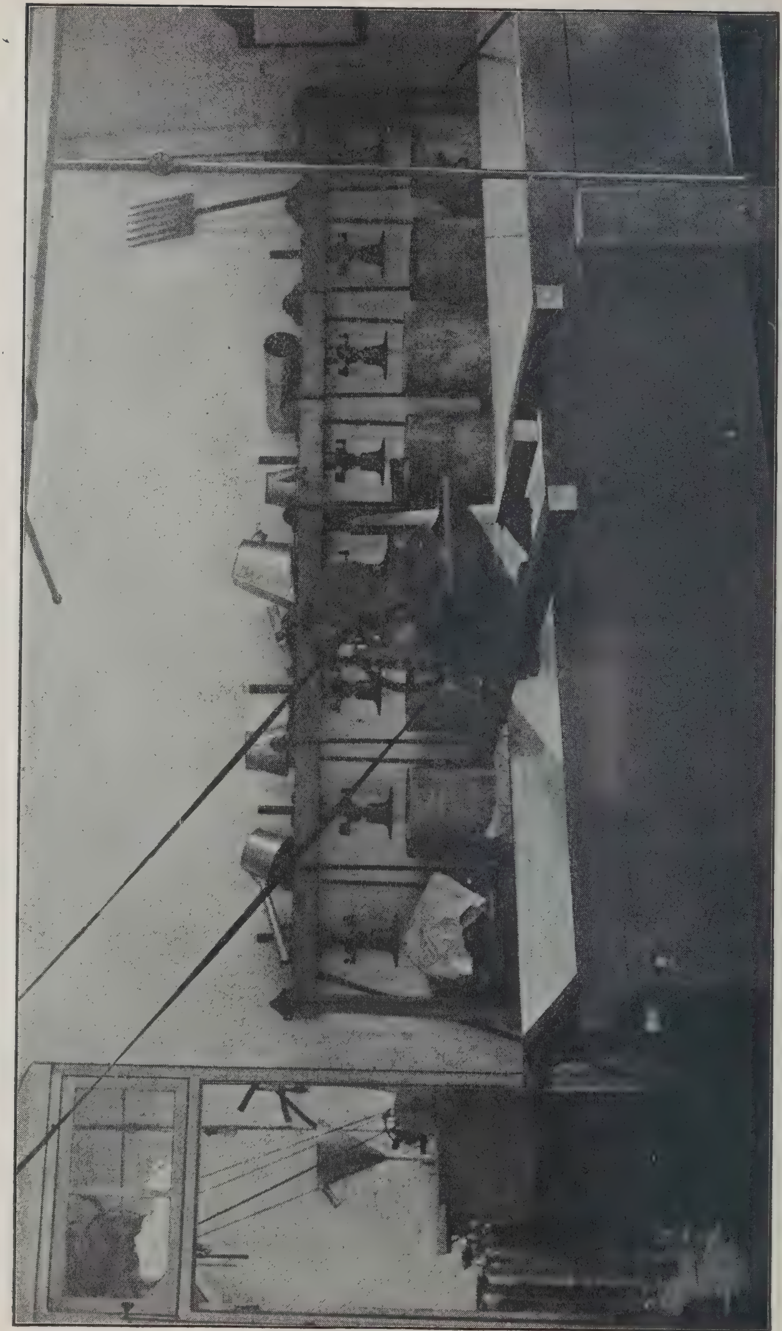
Cut 30. Churn Room. Neatly ceiled overhead; side walls brick painted white; floor and base for churn Cement; churn, vats, cream coil, and all Utensils kept clean.



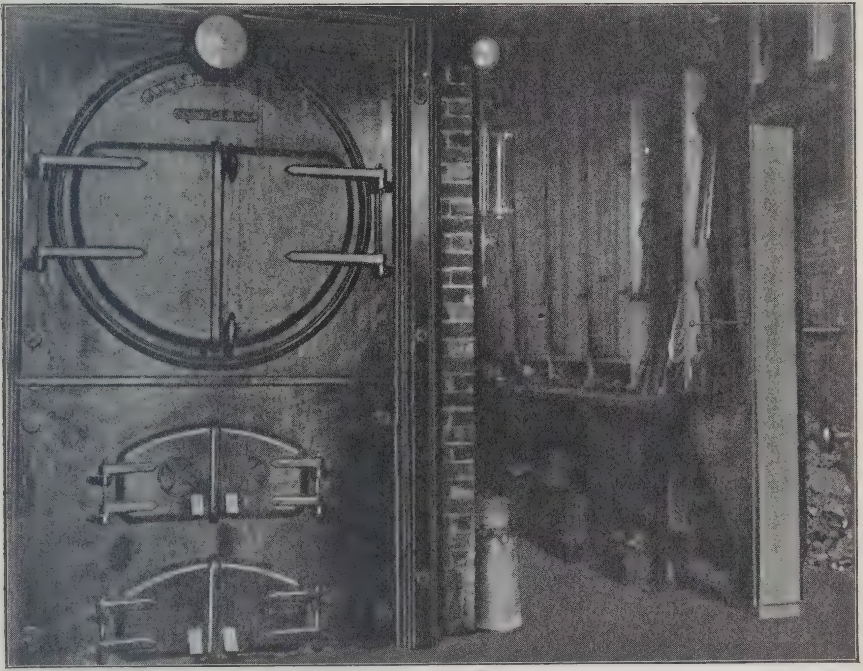
Cut 31. Working and Packing the Butter.



CUT 32. PRINTING BUTTER; STAMPING THE NAME INTO EACH POUND SO THAT THE CONSUMER MAY KNOW WHERE IT WAS MADE.



CUT 33. CHEESE ROOM. VATS, CURD MILL, UTENSILS, AND EVERYTHING IN ROOM, INCLUDING CEMENT FLOOR, WALLS, AND CEILING, KEPT CLEAN.

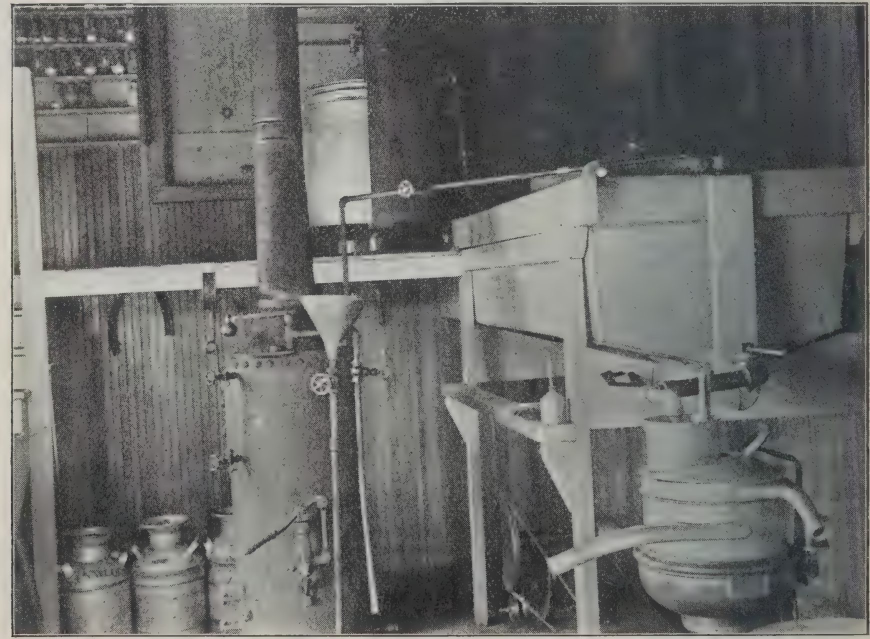


CUT 34. BOILER ROOM. TOOL CUPBOARDS AND WORKBENCH ON RIGHT; CLEAN CEMENT FLOOR EVEN IN COAL BIN; NO ASHES OR COAL DUST ALLOWED TO ACCUMULATE.

MARKET CONDITIONS.

In nearly all towns and cities of Illinois it is difficult to buy in the open market any really good butter or cheese. What little cheese is manufactured in the state is largely consumed in the immediate vicinity of the factories. Many dairy products are not up to modern standards because of unsanitary conditions. The public is becoming more intelligent and demanding better food products and dairymen should raise their standards and supply existing demands for products of good quality. Dairy products are of such a nature that people can and will do without them unless they are of good quality.

CUT 35. A SKIM STATION, OF WHICH THERE ARE FIVE, BELONGING TO CREAMERY JUST DESCRIBED.



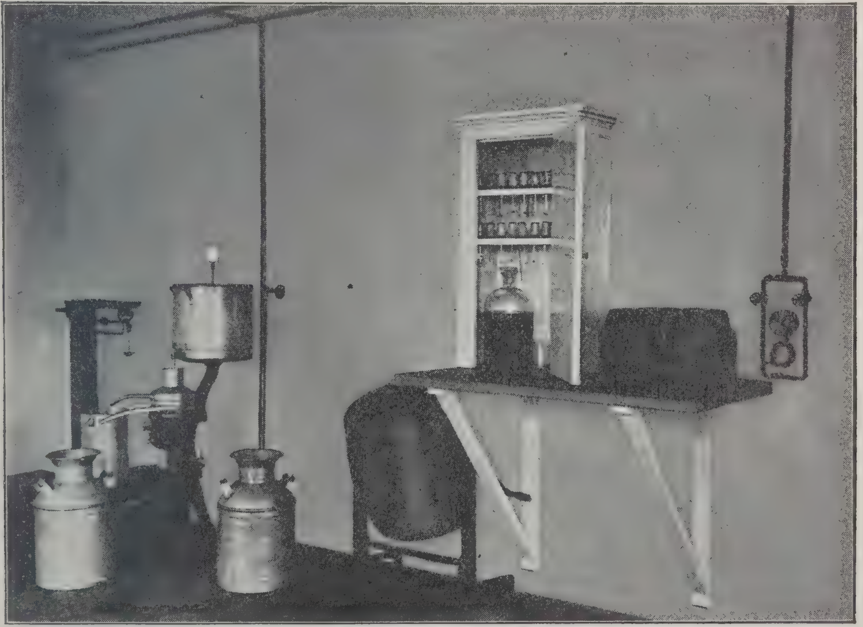
CUT 36. INTERIOR OF SKIM STATION SHOWING WEIGH-CAN, RECEIVING VAT, SEPARATOR, AND SMALL BOILER. ALL OF WHICH, INCLUDING THE FLOOR, WALLS AND CEILING, ARE KEPT CLEAN.

CUT 37. MILK HOUSE ON FARM SUPPLYING MILK FOR CREAMERY ABOVE DESCRIBED. AS SOON AS DRAWN, MILK IS RUN OVER A COOLER AND INTO CANS WHICH ARE THEN PLACED IN A TANK OF COLD WATER UNTIL TIME FOR DELIVERY.

One of the weak points in dairying, and in fact the whole of agriculture, is not having the products properly graded before they are sold. Dairy products are placed upon the market and as a rule sold under one of three names, milk, butter, or cheese. The purchaser has not the slightest idea when or under what conditions they were produced or manufactured. The result is that quality does not count for what it should and goods of high quality help to sell the poor. In other words good and poor products sell for too nearly the same price.

CUT 38. A WELL LOCATED CREAMERY HAVING GOOD DRAINAGE, A CEMENT FLOOR, STONE WALLS, AND EVERYTHING KEPT IN A CLEAN AND SANITARY CONDITION.

UT 39. HAULING MILK IN SPRING WAGON WITH CANS PROPERLY COVERED TO PROTECT FROM DIRT AND SUN.



CUT 40. A FARM DAIRY WITH CEMENT FLOOR, BRICK SIDE WALLS AND CEILING PLASTERED AND PAINTED WHITE.

If the quality of the goods is thoroughly acceptable and the consumer knows that the products are made in a sanitary manner and that their quality can always be depended upon, there will be no difficulty in securing a ready market at an advanced price.

The practical question then is, "What can be done to develop the dairy market?" As an answer to this the following is offered:

First and foremost produce a high class article.

Put up dairy products in such a manner that the consumer will get the original package.

Standardize and sell by grade and brand. Practice honesty and have grades exactly as represented.

Guarantee standards and invite inspection.

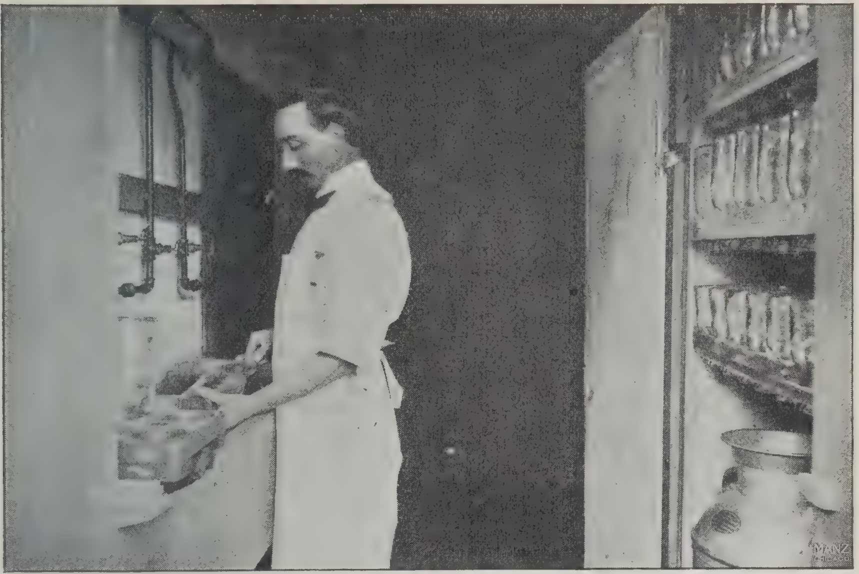
Publish the exact meaning of different grades and make people intelligent by putting out literature freely to educate them.

All places where dairy products are produced or manufactured should have standards of cleanliness and be open to inspection.

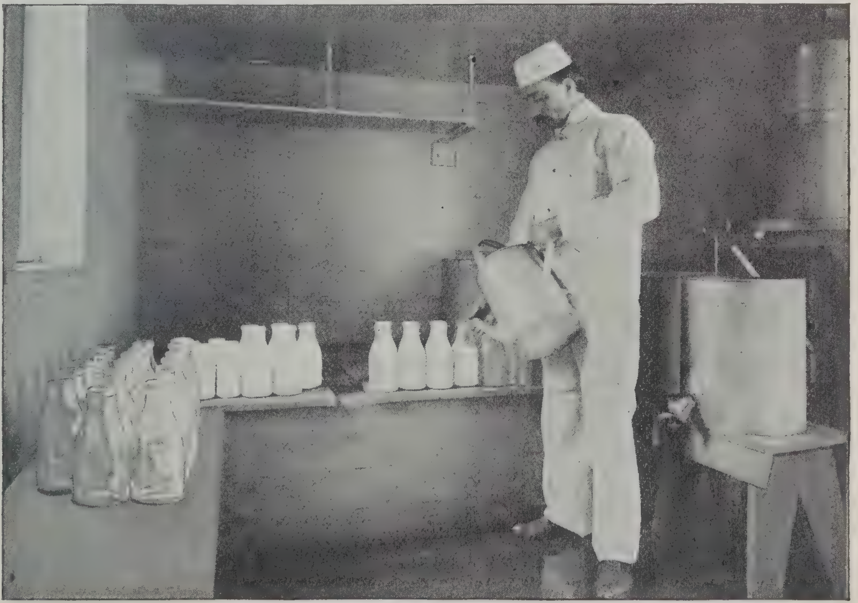
CLEAN MILK.

Milk free from dirt and in which the bacterial content is exceptionally small is essential for infants and invalids. A small amount of this kind of milk is produced and sold at present and the demand is constantly increasing as people learn of its advantages. There is no secret connected with the production of such milk. Cleanliness in every operation from first to last and thorough cooling as soon as drawn are the only requisites. The result is nothing more nor less than simply *clean milk.*

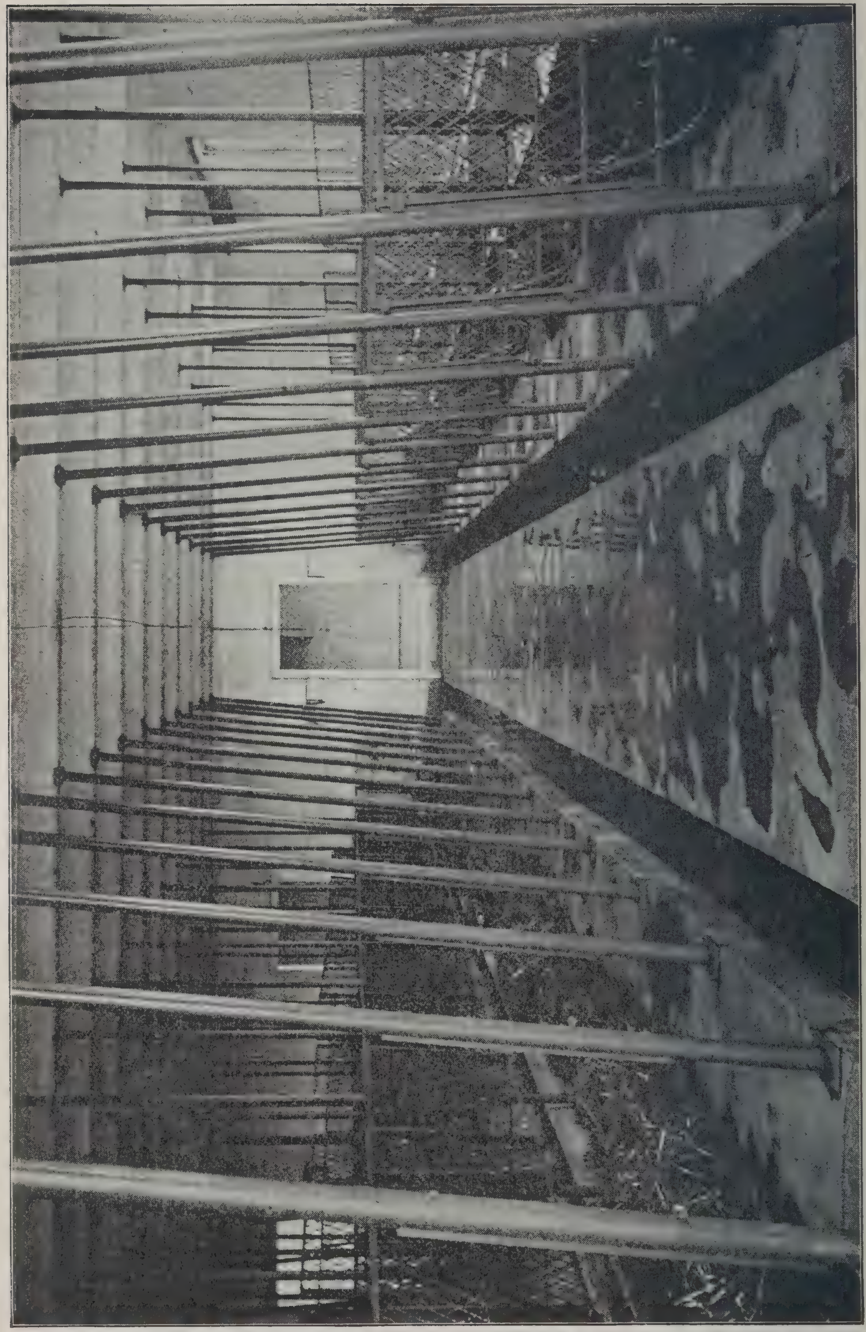
In the production of such milk all of the essentials mentioned in this bulletin in regard to the care of the cows, stables, utensils, and milk must be strictly followed. Before milking, the udders of the cows are always washed whether they appear soiled or not and the milkers put on clean suits kept for the purpose. As soon as cooled the milk is standardized, to whatever per cent. of butter-fat it is guaranteed to contain, and immediately bottled, which prevents any further contamination taking place until it reaches the consumer. As soon as bottled it is either packed in ice or placed



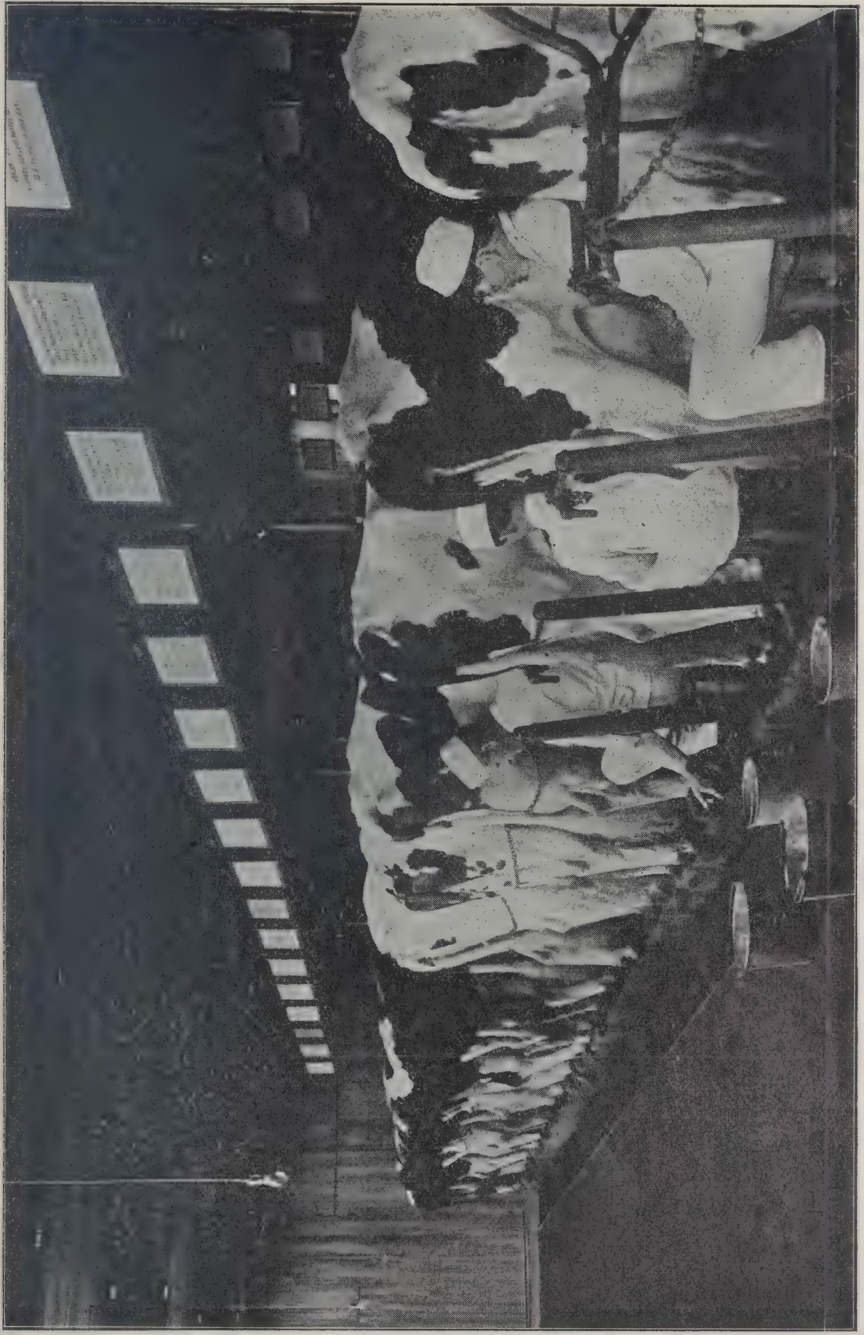
CUT 41. MILK BOTTLES AND DAIRY UTENSILS ARE WASHED AND RINSED IN SINK ON LEFT, THEN PLACED IN BRICK STERILIZER ON RIGHT, DOOR CLOSED AND LIVE STEAM TURNED IN FOR 20 MINUTES.



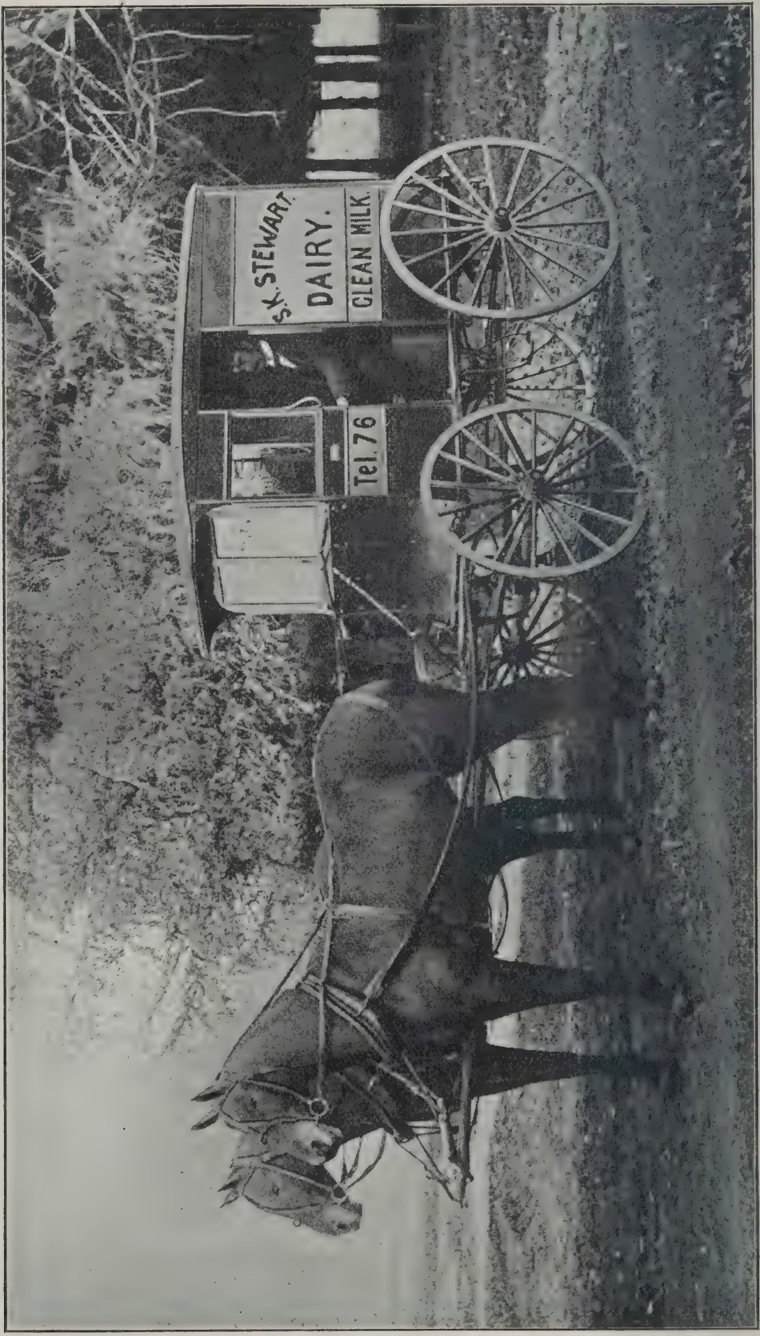
CUT 42. MILK BOTTLING ROOM. A SMALL ROOM WITH CEMENT FLOOR; EVERYTHING KEPT NEAT AND CLEAN.



Cut 43. A Sanitary Dairy Barn for the production of Certified Milk. Cement floor, iron stalls, sides whitewashed, well lighted and provided with a good system of Ventilation. Exterior shown in Cut 12.



Cut 44. Washing Udders before Milking.



CUT 45. THIS WAGON ADVERTISES THE KIND OF MILK DELIVERED.

That the question of the economy of securing a quick and perfect finish should not be overlooked, the corn and clover hay ration was compared with a ration calculated to produce a quicker finish or at any rate, a ration that would give to the steer on foot the appearance of being better finished. The ration selected for this comparison was corn, gluten meal, timothy hay, and corn stover. This ration was chosen because gluten meal is a corn product, and it is obvious that every pound of corn products that can be economically used in the feed lot has a tendency to make a better market for the corn produced on Illinois farms. Other things being equal, where the feeding of a nitrogenous concentrate is practicable it is good practice for the Illinois feeder to supplement corn with a nitrogenous concentrate the use of which has a tendency to enhance the value of products grown on Illinois soil. Such concentrates are to be found among corn products and the by-products of packing houses.

Timothy hay was used as part of the roughage in order to demonstrate that where clover hay or some other nitrogenous roughage is not available for feeding, a nitrogenous concentrate may be so used to supplement corn that the results obtained, from the standpoint of the producer, will be satisfactory.

That an instructive object lesson might be furnished to show the wastefulness of attempting to fatten cattle on corn without supplementing it with a nitrogenous food-stuff either in the form of a concentrate or of a roughage, a ration of corn and timothy hay was fed in comparison with the others mentioned. Since one lot was fed on corn and clover hay, the feeding of the corn and timothy hay ration made it possible to determine how much more valuable clover hay is than timothy, where fed with corn as the grain part of the ration.

That it might be determined whether or not the advantages of certain rations used in this experiment were real or apparent the cattle were sold on the Chicago market and the experiment terminated with a slaughter test.

Since the pork produced under ordinary feeding conditions is an all important factor, the effect of the various rations fed to the steers, upon the pigs following, was carefully noted.

The individuality of the steers comprising the various lots also received some study.

PLAN OF THE EXPERIMENT.

Animals used. The steers used in this experiment were purchased at the Union Stock Yards, Chicago, January 13th, 1902.

The order for these steers had been in the hands of Clay, Robinson & Co. for some time, but owing to the nature of the order, the season, and the supply of feeders reaching the market, it could not be promptly filled.

While it was thought advisable to secure fleshy feeders of good quality it was soon found impossible to do so, at any rate, on a basis that would leave a probable chance for profit in feeding.

Such steers as were available in the Chicago market at the time were purchased for use in this experiment. The steers selected were natives and all from the same lot so that it was known that up to the beginning of the experiment they had been similarly treated, an important factor in live stock experimentation readily recognized. They were of uniformly good colors, dehorned, very thin in flesh, and common to medium in quality. As indicated, while their colors were not objectionable, being largely reds, suggesting the presence of Shorthorn parentage, the form and general type of the steers was such as to indicate that they posessed only a small portion of beef blood. If they contained a high percentage of Shorthorn blood it must have been of the very plainest and most objectionable kind. The most conspicuous faults of these steers as ideal feeders were their long legs, narrow, somewhat peaked backs and rumps, their coarse rough bones, and flat ribs. Many also lacked length and depth of quarter and were deficient at the flanks. Such objectionable characteristics in feeding cattle usually suggest to the experienced feeder the unprofitableness of carrying them to a point where they would be prime in condition. The very fact that they were common in quality as feeders is sufficient evidence that, no matter how long they were fed, they would never possess prime quality.

Steers of good quality showing only a moderate amount of flesh were at this time selling for dressed beef at from $5.50 to $6.00 per hundred weight, a figure that seemed at the time almost prohibitive in considering them for feed lot purposes.

The steers used in this experiment averaged 917 pounds each and cost $4.60 per hundred weight, Chicago weights. The condition and quality of these steers was such that it rendered the consideration of a short feeding period impracticable. While the steers were common in quality and, as feeders go, common in condition, they were a very uniform lot rendering it a comparatively easy matter to separate them into three groups which were uniform and comparable as to age, thrift, condition, quality, and weight.

A few days after the steers reached the University farm, and after adding another steer of similar weight and quality purchased from W.C. Dallenbach of Champaign, they were divided into three lots of thirteen each on January 18th. In this division every effort was made to make the lots entirely comparable; in other words, so to divide the steers that had they been fed precisely the same and sold on the same market they would have brought the same price per hundred weight; that they would have made equally great and equally economical gains; and, finally, that they would have been equally profitable from the standpoint of the butcher.

Since the steers were a uniform lot, this did not appear to be a difficult task and the division as made seemed to leave little doubt in the mind of the author that the three lots entered the feeding test with equal opportunities. Whatever differences appear, therefore, during and at the end of the feeding period may be justly referred to the various rations fed.

To make it possible to determine the gains made by each steer during the feeding period and for convenience in recording data concerning the type and behavior of the steers from time to time an ear label bearing a number was inserted in the left ear of each steer. The steers in lot 1 were given numbers from 1 to 13 inclusive; in lot 2, from 14 to 26 inclusive; and in lot 3, from 27 to 39 inclusive. No. 15 in lot 2 proved absolutely worthless as a feeder and was accordingly sold to the butcher, on April 5th. As it was desirable to have each lot contain the same number of steers it was thought advisable to remove from each of the other lots one steer which would be as nearly comparable with No. 15 in lot 2 as possible. Accordingly No. 8 was taken from lot 1, and No. 27 from lot 3. These steers were also sold to the butcher, hence, the experiment was continued with twelve steers in each lot, Nos. 8, 15, and 27 not appearing in the notes on individual steers.

Pigs were provided to follow the steers to utilize whatever undigested food-stuffs passed through the steers. The first lot of pigs followed the cattle during the time they received shelled corn, the second lot from the time the feeding of the shelled corn was discontinued and the corn and cob meal feeding began until the end of the experiment.

When the plan of the experiment was outlined it was believed best to put enough pigs behind the steers to consume such part of the droppings as would be found available for pork production and limit the number so that food-stuffs other than that contained in the droppings of the steers would be unnecessary in order to secure satisfactory gains on the pigs. It is obvious, therefore, that to get the greatest benefits from the droppings and still determine the relative amount of pork that the undigested food in the droppings of each lot of steers would make, the number of pigs should be kept as small as possible, as under this system a minimum amount of food found in the droppings is used for the mere maintenance of the animal.

The feed racks were so constructed and the feeding done in such a manner that no grain was available for hog food that had not first passed through the steers. Results of former feeding experiments made it possible to determine approximately the percentage of corn fed to the steers that would eventually be available in the droppings for hog food. Careful computations convinced us that seven was the number of pigs for each lot of steers best calculated to serve all desired ends. As the experiment progressed the satisfactory gains of the pigs and the complete consumption of the whole corn found in the droppings indicated that the number decided upon was approximately correct.

The first lot of pigs were sired by a Duroc-Jersey boar, their dams being Poland-Chinas and Chester Whites. The second lot were decidedly mixed in breeding, but the Duroc-Jersey blood predominated although some of the pigs showed evidences of Yorkshire, Chester White, and Poland-China blood. The first lot were purchased at $5.75 per hundred weight, February 1st, of Wm. Reynolds and H. W. Hunsley of Champaign and the second lot of C. T. Iungerich, Staley, Illinois, and J. DeYoung, Urbana, Illinois. The first lot were 130-pound thrifty shotes of good quality, but rather more fleshy than is thought ideal for such uses. The second lot were in good thrift. They were bought off the pasture weighing an average of 136 pounds. Those purchased of Mr. Iungerich cost $6.50 per hundred weight, and those of Mr. DeYoung, $6.00 per hundred weight. Both lots were sold to T. J. Colvin of Urbana, Illinois, the former lot at $6.50 and the latter at $7.00 per hundred weight.

SHELTER, FEED LOTS AND WATER SUPPLY.

Beginning with the purchase of the steers in the Chicago Union Stock Yards and ending with their final disposition there, the conditions surrounding steers and pigs used in this experiment were made comparable in every particular with average feed lot conditions in Illinois. Whether such conditions are as they should be is not a subject for discussion here. Suffice it to say, that it is the opinion of the author that were the average feed lot conditions brought up to the standard of the best practice of our most successful and progessive feeders, it would not be in good taste for any man to criticise such conditions without being sure of his ground and even then such criticism would be valueless unless the critic had something better to suggest.

The feed lots prepared for this experiment were laid out on an old well established blue grass sod, the whole sloping slightly to the south. The soil was of the deep, black, prairie loam order so characteristic of Central Illinois. Each lot was 36 x 60 feet, being longest north and south, with a twelve-foot open shed running along the north side. The feed lot to the extreme west was further protected by a five-foot tight board fence and a single row of trees, which served as a wind-break. The lots, and more especially the part immediately under the sheds were frequently bedded, an effort being made to make it possible for the steers to have access to a dry, clean place to lie down even when the lots were otherwise very muddy. Aside from the floor of the lots they could not be criticised from the standpoint of furnishing comfort to the steers. Deep, black, prairie soil is not suitable, however, for small feed lots. It is the opinion of the author that where such soil only is available for feed lots it will be economy to make some provision for keeping the cattle out of the deep mud during bad weather. This subject is receiving attention at the Illinois Experiment Station.

Water was furnished the steers from the University plant and was stored in galvanized steel tanks so that the steers had access to fresh, pure water at all times except when it was withheld, as was the rule just before each weighing. The tanks were banked to prevent as far as possible severe freezing, but no attempt was made to keep the water warm.

FOOD-STUFFS AND RATIONS.

The food-stuffs used were shelled corn, corn and cob meal, corn meal, gluten meal, clover hay, timothy hay, and corn stover. The prevailing prices for such food-stuffs f. o. b. cars, Champaign, Illinois, during the winter season of 1901–'02 were as follows:

Shelled corn	$21.43	per ton or 60c per bu.
Corn meal	23.03	" "
Corn and cob meal	19.14	" "
Corn stover, shredded or cut, baled	6.50	" "
Timothy hay, baled	14.00	" "
Clover hay, baled	11.00	" "
Gluten meal	28.00	" "

The rations fed to the three lots from February 8th, to April 12th were as follows:

Lot 1. Corn and clover hay.
Lot 2. Corn, timothy hay, and corn stover.
Lot 3. Corn, gluten meal, timothy hay, and corn stover.

From April 12th to June 14th the rations were as follows:

Lot 1. Corn and cob meal, and clover hay.
Lot 2. Corn and cob meal, timothy hay, and corn stover.
Lot 3. Corn and cob meal, gluten meal, timothy hay, and corn stover.

A small percentage of the corn part of the ration of lot 3 was corn meal, which was fed because it could be more thoroughly mixed with the gluten meal, in which form the steers seemed to relish the gluten meal better than when fed otherwise.

The feeding of corn stover was discontinued on April 23d.

PRELIMINARY FEEDING.

The preliminary feeding lasted three weeks beginning with January 18th and continuing until February 8th, during which time the steers were gradually started on rations similar to those subsequently fed in the experiment.

During this preliminary feeding a relatively large proportion of the ration of all the steers was roughage, a comparatively light grain ration being fed, the latter only reaching ten pounds daily to each steer at the end of the preliminary feeding while the roughage consumed was practically double that amount. Taking the whole of the preliminary feeding period into account the proportion of grain fed to roughage fed was as 1 : 3.24. The average daily gain of each steer for the twenty-one days was 2.44 pounds. The grain consumed per pound of increase in live weight was 2.91 pounds and of roughage 9.43 pounds. On this basis each bushel of corn produced nineteen pounds of gain. Such results are to be anticipated when well shrunk, thin feeding steers are placed in the feed lot and permitted the luxury of more liberal feeding.

METHOD OF FEEDING STEERS.

The experiment proper began February 8th and from that date throughout the experiment the steers were fed grain and roughage twice daily, grain being fed before the roughage. During the winter months, they received their grain at seven a. m. and at four p. m., the roughage being fed as soon as the grain ration was consumed. As the season advanced the morning ration was fed earlier in the day. About the first of April it seemed advisable either to grind or to soak the corn fed to the steers; and as ear corn was available and the grinding of the grain, cob and all, promised to add value to the experiment by making it possible to secure data on the subject of the influence of meal feeding to steers, upon the pigs following, the latter course was decided upon. During the first two weeks of April, therefore, the three lots of steers were accustomed to receiving their grain as meal rather than as whole grain by a gradual substitution of corn and cob meal for a part of the whole corn fed. From April 12th until May 31st the various lots received all their corn in the form of corn and cob meal. During the last two weeks of the experimental period, or between May 31st and June 14th, some corn meal was substituted for a part of the corn and cob meal.

As has been stated elsewhere each steer in the different lots was getting an average daily grain ration of ten pounds at the beginning of the experiment proper on February 8th. This was gradually and somewhat rapidly increased during the next few weeks and more slowly toward the end until at the termination of the experiment each steer in lot 1 was getting a daily grain ration of 25.4 pounds ;each steer in lot 2, 22.6 pounds, and each steer in lot 3, 21.7 pounds.

Concerning the roughage part of the ration it may be stated that lot 1 received clover hay as the only roughage; however, timothy hay was fed to this lot for two days before shipping them to market, as it is believed that cattle so fed will shrink less, and are less liable to bloat in transit. This use of timothy hay is not material since it did not take place until after the final weights of the experiment were secured. The appetites of the steers furnished the basis for determining the amount of clover hay fed from day to day, the steers being given all they would consume without material waste during the greater part of the feeding period; however, as the steers showed a tendency to be paunchy it was thought advisable to restrict the amount of hay fed during the latter part of the experiment.

The quality of the clover hay was much better during the latter than the early part of the experiment. In general, it may be stated that the quality of the clover hay was good. Lots 2 and 3 received their roughage in the form of timothy hay and corn stover. The corn stover was shredded during the early part of the experiment and cut during the latter part. In this experiment it could not be said that the one method of preparing the stover was to be preferred to the other; the steers did not consume any considerable amount of the coarser portions of the stalk in either case. The feeding of corn stover being discontinued on April 23d, lots 2 and 3 received from that date timothy hay as their only roughage.

Both the steers and the pigs were weighed every two weeks. The initial weights were secured by taking the average of the weights on February 6th, 7th, and 8th. In securing the weights at the beginning of the experiment and all subsequent weights, the steers were weighed immediately after they had consumed their morning feed of grain, and before roughage was given them, water having been withheld since the night before.

SPRAYING FOR LICE.

Soon after the steers arrived at the University farm it became evident that they were badly infested with lice. For some time unusually cold weather rendered it impracticable to treat the steers. The weather moderated sufficiently so that on March 11th, lot 1, on March 14th, lot 2, and on March 19th, lot 3 were treated with a ten per cent. solution of kerosene emulsion. A chute was constructed into which a single steer could be driven and confined until thoroughly sprayed with this emulsion. The time required thus to treat each steer varied from five to ten minutes. It required about six quarts of the emulsion to spray thoroughly a steer. The cost of materials amounted to about one cent per steer. This is an efficient remedy for lice when it can be conveniently applied.

As the steers were weighed every two weeks and careful weighings made of each feed the steers received, data are at hand with which to construct tables showing the relative amount of food consumed, together with the actual gains in live weight, by periods, throughout the experiment. It is believed that an enumeration of such points as are important will better serve the object of this bulletin than a reproduction of these complicated tables.

Following the common practice of feeders, the maximum amount of roughage and the minimum amount of grain was fed to the steers during the first few weeks. During the progress of the experiment this relation between the amount of roughage and grain fed was reversed so that at the end of the experiment the steers were getting their maximum grain ration and their minimum roughage ration. In order to emphasize how complete this change was it may be stated that during the first two weeks of the experiment each steer in lot 1 received a daily ration of 12.47 pounds grain and 18.39 pounds roughage, the proportion of grain to roughage being 1 : 1.47. At the end of the experiment each steer in lot 1 received an average daily ration of 25.4 pounds grain and 8 pounds roughage, the proportion being as 1 : .312. In connection with the feeding practice noted above, lot 1 was not materially different from lots 2 and 3.

It is a well known fact that roughage contains a much larger percentage of cellulose than do most concentrates. Since a ration made up quite largely of cellulose would naturally require greater digestive activity than one containing a relatively smaller amount of cellulose, and since in fattening the animal and especially during the latter part of the feeding period it is the aim to force the animal up to a point where its digestive capacity is utilized to the best advantage, the feeding of a relatively small percentage of roughage during the last stages of fattening would appear to be good practice. The feeding of a ration made up of a large proportion of roughage is relatively a small ration and, since the digestive capacity of an animal remains practically constant, a ration of greatest fattening efficiency must not be made up too largely of roughage. Then again steers are likely to show too much paunchiness if permitted free access to varieties of roughage of which they are particulary fond, unless, as is sometimes the case, they are getting an unusually heavy grain ration.

Condition of Feed Lots as Affecting Extent and Cost of Gains.

Within any given lot of steers the extent of the gains made and the relative economy of such gains appeared to be more dependent upon the condition of the feed lots and general atmospheric conditions than upon the amount or nature of the food-stuffs fed, or upon the generally recognized important factor of whether the gains made are during the early or latter part of the fattening period. To illustrate, it may be stated that whenever the feed lots were dry and the variations in the weather but slight and those gradual, there was but very little difference either in the extent of the gains made or the economy of such gains from period to period; on the other hand whenever the lots were extremely muddy and the variations in temperature and humidity great and sudden, the gains of the steers were not only much smaller, but were decidedly more expensive. This suggests that possibly we have not attached enough importance to providing fattening steers with comfortable feed lots. Since the condition of the lots in this instance was beyond our control any deductions that might be made from data in hand relative to the expense of gains during the early and the latter part of the feeding period would be valueless.

After all has been said the reader should not conclude that the conditions surrounding the steers in this experiment were unlike the average feed lot conditions in Illinois, and while the total gains were not as large as are sometimes reported they are still creditable, and when the cost of such gains is considered, they are above results usually obtained. The results are valuable as showing what feeders may reasonably expect from feeding the products of Illinois land to feeding cattle of the common and medium grades under average corn belt conditions.

TABLE I.

FEED OF STEERS FOR EIGHTEEN WEEKS.

	Lot. 1 Corn, clover hay	Lot 2 Corn, timothy hay, corn stover	Lot 3 Corn, timothy hay, corn stover, gluten meal
Total weight whole corn	13187	12639	7743.5
Total weight corn meal	928	817	1284.5
Total weight corn and cob meal	16173	15181	13234
Total weight gluten meal	....	....	4188.5
Total weight clover hay	19027	....	....
Total weight timothy hay	....	10738	11917
Total weight corn stover	....	6343	6362
Total weight dry matter	42407	38275	38113
Total weight grain	30288	28637	26450.5
Total weight roughage	19027	17081	18279
Average daily grain per steer	19.54	18.37	17.7
Average daily roughage per steer	12.06	10.78	11.57
Proportion grain to roughage	1 : .628	1 : .596	1 : .691
Nutritive ratio	1 : 9.43	1 : 13.03	1 : 9.42

Table 1 exhibits the total amount, the amount of the various kinds of grain and roughage fed the steers, total dry matter, average daily gain per steer, gain per hundred pounds dry matter, and the amount of grain and roughage per pound of gain. Lots 2 and 3 received the same kinds, quality, and practically the same amounts of roughage, viz., timothy hay and corn stover although lot 3 consumed slightly more of each. It is just to conclude, therefore, that the addition of gluten meal to a ration of corn, timothy hay, and corn stover for steers increases their appetite for roughage. This they will consume with less waste than where corn is the only concentrate used.

It should be noted that lot 1 consumed more dry matter than either lots 2 or 3 and that lots 2 and 3 consumed practically the same amount; that lot 1 not only consumed more food, but made practically as good use of it as did lot 3 and considerable better use of its food than did lot 2, as is shown by the gains per hundred pounds dry matter consumed. See Table 3.

The average daily grain fed was in each instance under twenty pounds. Lot 1 receiving an average of 19.54 pounds; lot 2, 18.37 pounds; and lot 3, 17.7 pounds grain daily. The average daily roughage fed per steer was to lot 1, 12.06 pounds; lot 2, 10.78 pounds; and to lot 3, 11.57 pounds. It will be seen from this that the greatest gains were secured when the most roughage was fed, namely, in lot 1; this should be attributed not so much to the larger proportion of roughage as to its nature, since it is a highly nitrogenous roughage.

It is significant that there was considerable waste of corn stover in attempting to feed it along with timothy hay as the roughage for fattening steers. It is believed that corn stover could be more economically fed with some roughage like clover hay, rich in nitrogen, than with timothy hay, conspicuously poor in nitrogen.

By referring to the Table it will be seen that the nutritive ratios of the rations fed to lots 1 and 3 are very nearly alike, and that the nutritive ratio of the ration fed to lot 2 is very wide. The results of this and other experiments show that where food-stuffs are so combined as to form as wide a nutritive ratio as that employed in feeding lot 2, fattening steers can not make economical use of them and the chances are that under avarage conditions the persistent adherence to such a ration would more often result in loss than in profit to the feeder. The rations fed to lots 1 and 3 though narrow as compared with the rations fed lot 2, are still much wider than those conforming to standard rations which are theoretically rations of greatest economy.

Conditions during the past season were materially different from average conditions, so far as the relatively high cost of food-stuffs low in nitrogen are concerned. Highly nitrogenous concentrates were selling relatively cheaper than corn. The comparative cost of these two classes of food-stuffs in the corn belt is such that it is seldom profitable for stock-raisers to use a ration that is theoretically of greatest efficiency. The most profitable ration therefore, would appear to be one where corn is supplemented with a nitrogenous roughage, as clover hay, with possibly an addition of a limited amount of some highly nitrogenous concentrate.

GAINS IN WEIGHT OF PIGS FOLLOWING STEERS.

Very little experimental evidence is in existence from which to form even an approximate estimate as to the proportion of whole corn or meal fed to the steers which, in making up a final statement in regard to the profits of the cattle feeding industry, might be justly charged up to the pig or pork produced and there is much less to furnish data concerning the effect of various rations fed to the steers, upon pigs following.

This experiment will throw some light on these very important questions. As would be expected, the pigs following all the above lots of steers did not make satisfactory gains during the first two weeks, not because there was not sufficient grain available for their consumption in the droppings, but because they were not accustomed to getting their feed in this way. As will be seen, after this first two weeks' period the pigs did make very satisfactory gains from the droppings of the steers alone, so long as they received their grain in the form of shelled corn. Notwithstanding the fact that the number of pigs following the various lots was reduced from seven to four when the feed of the steers was changed from shelled corn to corn and cob meal, the pigs did not make gains which would be looked upon as satisfactory. In order to secure the benefit of whatever undigested particles of food there may have been in the droppings of the meal-fed steers, pigs would be obliged to consume a large part of the droppings, but the pigs following these lots did not consume any large part of the droppings since much was left untouched. It is very probable, therefore, that more pigs following the steers during the time they received the meal ration would have made equally good gains as did the four. This leads us to the conclusion that it cannot be said that the amount of pork produced by the pigs following the meal-fed steers is the maximum amount that might be produced from the droppings of an equal number of meal-fed steers when followed by more pigs than were used in this experiment. On the other hand, the conclusion was reached that the amount of pork produced by the pigs following the steers when receiving shelled corn is approximately the maximum amount that may be expected under like conditions, since the daily gains made by the pigs were satisfactory and since the droppings of the steers appeared to be thoroughly worked over.

By referring to Table 2 it will be seen that the same number of pigs of practically the same weight followed each lot of steers, both during the time the steers received shelled corn and when they received corn and cob meal; that the total gain of the pigs following lot 1 was 542 pounds; of pigs following lot 2, 482 pounds, and of pigs following lot 3, 422 pounds. By this it will be seen that considerably the largest gains were made by the pigs following the steers getting a ration of corn and clover hay. It is approximately correct to attribute this extra gain to the influence of the clover hay in the ration of the steers, for, notwithstanding the fact that the steers in lot 2 did not get as much corn as the steers in lot 1, the pigs following lot 2 undoubtedly had as much corn at their disposal for pork production as did the pigs in lot 1, since the corn and clover hay ration fed to lot 1 was more effective for beef production, as will be seen in Table 3, than the corn and timothy hay ration fed to the steers in lot 2. The gain of pigs in lot 1 was greatest; in lot 2, 11 per cent. less, and in lot 3, 22.1 per cent. less than in lot 1.

The conclusion that the clover hay in the ration of lot 1 was an advantage to the pigs following, is further substantiated by the fact that more pounds of pork were produced per 100 pounds of grain fed the steers in lot 1 than in either of the other lots. This statement holds true whether the corn was fed as shelled corn or as corn and cob meal.

Table 2 also shows that the pigs following lot 3 not only made the smallest total gain of any of the lots, but also that the number of pounds of pork produced by them for each 100 pounds grain fed the steers was considerably less, both when the steers were fed shelled corn and when they were fed meal. This circumstance should not be passed without careful consideration. Before

TABLE 2.

GAINS IN WEIGHT OF PIGS FOLLOWING STEERS.

		PERIODS.									
		Feb. 8 to Feb. 22.	Feb. 22 to March 8.	March 8 to March 22.	March 22 to April 5.	April 19 to May 3.	May 3 to May 17.	May 17 to May 31.	May 31 to June 14.	Totals,	Average.
Lot 1—Steers fed corn and clover hay.	Number of pigs............	7	7	7	7	4	4	4	4	....	.....
	Weight of lot at beginning of period................	908	955	1100	1205	565	580	595	625	....	.....
	Gain of lot................	47	145	105	150	15	15	30	35	542	.....
	Average daily gain per pig.	.48	1.48	1.07	1.53	.267	.267	.536	.625	....	.....
	Gain of pigs per 100 lbs. ground grain fed to steers	....	....	....	....	....	....	....	....	....	.616
	Gain of pigs per 100 lbs. whole grain fed to steers..	....	....	....	....	....	....	....	....	....	3.78
Lot 2.—Steers fed corn, timothy hay corn stover.	Number of pigs............	7	7	7	7	4	4	4	4	....	.....
	Weight of lot at beginning of period................	903	990	1090	1200	570	585	610	625	....	.....
	Gain of lot................	87	100	110	100	15	25	15	30	482	.....
	Average daily gain per pig.	.888	1.02	1.12	1.02	.267	.446	.267	.556	....	.....
	Gain of pigs per 100 lbs. ground grain fed to steers	....	....	....	....	....	....	....	....	....	.594
	Gain of pigs per 100 lbs. whole grain fed to steers..	....	....	....	....	....	....	....	....	....	3.665
Lot 3.—Steers fed corn, gluten meal, timothy hay, corn stover	Number of pigs............	7	7	7	7	4	4	4	4	....	.....
	Weight of lot at beginning of period................	933	1010	1110	1200	570	585	605	595	....	.....
	Gain of lot................	77	100	90	95	15	20	−10	35	422	.....
	Average daily gain per pig.	.786	1.02	.92	.97	.267	.36	−.178	.625	....	.....
	Gain of pigs per 100 lbs. ground grain fed to steers	....	....	....	....	....	....	....	....	....	.447
	Gain of pigs per 100 lbs. whole grain fed to steers....	....	....	....	....	....	....	....	....	....	3.395

drawing conclusions as to the reasons for this somewhat unlooked for condition it is well to examine the facts at hand. It should be observed that the steers in lot 3 receiving corn, gluten meal, timothy hay, and corn stover were fed a fewer number of pounds of dry matter than either of the other lots, (more roughage than lot 2, but less grain, and both less grain and less roughage than was fed lot 1). The roughage parts of the rations of lots 2 and 3 were practically the same, gluten meal being the only factor of difference between the two rations on the side of the concentrates used. In case exactness is required it should be stated that 1000 pounds more roughage was fed to lot 3 than to lot 2 in a feeding period of 18 weeks or .66 of a pound more per steer per day, certainly not a great difference. Lot 3 made more beef and a total of more meat than lot 2 and still lot 3 received less corn and a total of less grain than lot 2. The very slight difference in the amount of roughage fed to lots 2 and 3 in no way accounts for the wide variation in the gains made. The corn, gluten meal, timothy hay, and corn stover ration must therefore, be pronounced a much more effective ration than the corn, timothy hay, and corn stover ration.

The amount of dry matter required for each pound of beef made was practically equal in lots 1 and 3. This shows that for beef production the corn and clover hay ration and the corn, gluten meal, timothy hay, and corn stover ration were practically equally effective. The relative total amounts, therefore, of food-stuffs used for beef production in lots 1 and 3 reappearing in the droppings of the steers and therefore available for pork production bear precisely the same relation to each other as do the relative amounts of dry matter fed the steers in each instance. The least digestible part of the rations of each lot was the roughage; there was more roughage fed to lot 1 than either to lot 2 or lot 3 although the roughage fed to lots 2 and 3 was less digestible than that fed to lot 1. However, it should be borne in mind that even if there were the same relative amounts of food in the droppings of the two lots of steers available for pork production, the part in the droppings of lot 1 would be more available for the use of the pigs than that in the droppings of lot 3 since a large part of it would be whole corn. Whatever differences exist between the two lots, so far as pork production is concerned, other than those which would naturally arise from the difference in the amount or availability of the food-stuffs in the droppings must be attributed either to the beneficial influence of some constituent in the one ration upon the growth or fattening of the pigs, or to the detrimental effect of some constituent or combination of constituents in the other, or both.

TABLE 3.

GAINS IN WEIGHTS OF STEERS AND PIGS FOR EIGHTEEN WEEKS.

	Lot 1. Corn, clover, hay.	Lot 2. Corn, timothy hay, corn stover.	Lot 3. Corn, timothy hay, gluten meal, corn stover.
Total gain in weight of steers	3944.5	2900	3555.5
Average daily gain per steer	2.51	1.858	2.268
Average grain per pound gain	7.68	9.87	7.44
Average roughage per pound gain	4.82	5.88	5.14
Average dry matter per pound gain	10.75	13.20	10.72
Average gain per 100 lbs. grain	13.02	10.13	13.44
Total gain in weight of pigs	542.	482	422
Pork produced per 100 lbs. whole grain	3.78	3.665	3.395
Pork produced per 100 lbs. ground grain	.616	.594	.447
Total beef and pork produced	4486.5	3382	3977.5
Grain per pound meat	6.75	8.47	6.65
Roughage per pound meat	4.24	5.05	4.6
Dry matter per pound meat	9.45	11.32	9.58

The relatively greater effectiveness of the corn and clover hay ration as compared with the corn, timothy hay, and corn stover ration for beef production has been clearly shown by the records of this experiment. That the advantage of the former ration was due entirely to the nature of the roughage fed is probable since corn was the concentrate in both instances. Notwithstanding the fact that the corn and clover hay ration was more effective for beef production, it appeared also to be very favorable to pork production, as more pork was produced by the pigs following lot 1 and more pork per pound of grain fed to the steers, than in either of the other lots. The relatively good showing made by the pigs following lot 2 can not be attributed to any superiority of the ration fed the steers for pork production, but may be justly referred to the fact that such ration was less effective as a beef producing ration, there naturally being more undigested and hence, more available hog feed in the droppings. Care should be taken not to conclude that the ration fed to lot 2 is to be preferred even for pork production to other rations used in this experiment simply because more pork was produced by the pigs following this lot nor should we conclude that the ration fed to lot 3 was one unfavorable to pork production simply because less pork was produced by the pigs following the steers getting corn, gluten meal, timothy hay, and corn stover. By far the larger part, if not all, of the apparent disadvantage of the ration fed to lot 3, as regards the pork producing factor in this experiment, is accounted for in the fact that less food was to be found in the droppings of steers in lot 3 not only because there was less in absolute quantity fed to the steers, but also because that used was relatively more effective for beef production and also that the quantity of food-stuffs in the droppings was more available for pigs in the droppings of lots 1 and 2 than in the droppings of lot 3. After all, the important factors to be considered from the standpoint of the beef producer are the relative total amounts of beef and pork produced from a given ration, the relative quality or value of the products and the relative cost of such rations. Since the principal object is the production of beef, a ration that tends to produce good gains which are largely gains in beef rather than pork is to be commended rather than condemned. In examining the records of this experiment, Table 3, we find that the total amount of beef and pork produced during the eighteen weeks of this experiment was in lot 1, 4486.5 pounds, lot 2, 3382 pounds, and lot 3, 3977.5 pounds; that the relative amounts of food-stuffs required for producing these gains do not bear the same relation to each other as do the gains, there being a slight advantage of the ration fed to lot 3 over that fed to lot 1, and a decided and all important advantage over that fed to lot 2 by both lots 1 and 3. The advantage in the economical production of meat exhibited by lot 3 over the other lots is made more far-reaching when we consider the relative values of the three lots as sold in the open market, lot 1 selling for $7.30, lot 2, for $7.00, and lot 3, for $7.45 per hundred weight.

It should also be borne in mind that under normal conditions the ration fed to lot 3 where corn was supplemented by the concentrate, gluten meal, has against it its greater cost as compared with the ration fed lot 1 where corn was supplemented by the roughage, clover hay, and still further that while clover hay would materially add to the fertilizing value of the manure made by the steers in lot 1, gluten meal feeding would not add materially to the fertilizing value of the ration fed lot 3, as compared with lot 1. Nitrogenous roughages are available or should be on every Illinois farm. Where they are not it will be economy to purchase nitrogenous concentrates, and undoubtedly, to a limited extent where nitrogenous roughages are available.

MARKET AND SLAUGHTER TESTS.

The steers were shipped from Champaign on the evening of June 22d thus making it posssible to have them on the market Monday morning, June 23d.

Table 4 exhibits the weight of the steers at Champaign, their live and dressed weight in Chicago, the per cent. of shrinkage, together with the weights by lots of the hides, caul fat, ruffle fat, gut fat, gut ends, and loose fat. The total weight of each of the three lots of steers at the beginning of the experiment was practically equal, the lightest weight lot being lot 1 which was 42 pounds less than lot 2 and 134 pounds less than lot 3. As sold in Chicago lot 1 was the heaviest of the three being 1107 pounds heavier than lot 2 and 290 pounds heavier than lot 3.

TABLE 4.

SHIPPING AND SLAUGHTER WEIGHTS OF STEERS.

	Lot. 1.		Lot. 2.		Lot 3.	
	Total.	Average.	Total.	Average.	Total.	Average.
Weight at Champaign June 21............	15585	1299	14555	1213	15370	1281
Weight at Chicago June 23............	15170	1264	12890*	1172	14880	1240
Percentage of shrinkage...............	....	2.7	....	3.38	....	3.2
Shrinkage per steer..	....	35	....	41	....	41
Dressed weight of carcasses.............	8936	745	7376*	671	8591	716
Percentage of carcass to live weight......	....	58.9	....	57.2	....	57.7
Weight of hides.......	916	76	780	71	907	76
Weight of caul fat....	263	....	207	....	247	....
Weight of ruffle fat...	212	....	165	....	185	....
Weight of gut fat.....	736	....	571	....	662	....
Weight of gut ends...	62	....	44	....	51	....
Weight of fat.........	1273	106	987	90	1145	95

*In the total weights of cattle on foot in Chicago as sold, of the dressed beef, fat and hides of lot 2, only eleven steers are concerned, while the total weights for lots 1 and 3 and the Champaign weights of lot 2 represent twelve steers.

The shrinkage in shipping of the steers in lots 2 and 3 were practically the same being an average of 41 pounds per steer while the average shrinkage per steer in lot 1 was only 35 pounds. The steers in lot 1 dressed out 58.9 per cent. of beef, and 8.4 per cent. of fat; lot 2, 57.2 per cent. dressed beef and 7.7 per cent. of fat; lot 3, 57.7 per cent. of dressed beef, and 7.02 per cent. of fat. These figures clearly show that lot 1 led both in percentages of dressed beef and fat, lot 3 coming second as to percentage of dressed beef and third as to fat; lot 2 standing second as to fat and third as to percentage of dressed beef. From the fact that lot 3 dressed a higher percentage of dressed beef and a lower percentage of fat than lot 2, and from the fact that much greater gains were secured upon the steers in lot 3 than in lot 2, it is evident that the corn, gluten meal, timothy hay, and corn stover ration was more conducive to the production of lean beef or flesh than to the production of fat while the corn, timothy hay, and corn stover ration was more conducive to the production of internal fat than to beef and especially of lean beef.

The effect of the rations fed to the three lots seems to have extended even to the hides for the relative weights of the hides of the different lots correspond with the live weights and the weights of dressed beef. The differences in the percentages of dressed beef and fat of the different lots though apparently small are still large enough to be of great importance to the packer. A few pounds of dressed beef and a few pounds of fat extra on every beast slaughtered by the packer soon add up to vast sums of money.

At this time prime packers tallow was worth 7⅜, cents and green salted hides worth 7¾ cents per pound. In computing the value of the hides and tallow an allowance was made of 16 per cent. for shrinkage in the weight of the fresh hide during the curing process and of 30 per cent. in the weight of the rough tallow for shrinkage in rendering. The meat from lot 1 was adjudged worth 10¾ cents per pound, from lot 2, 10 cents per pound and from lot 3, 10½ cents per pound. As there was no satisfactory method of estimating the value of the offal parts aside from the fat, such as hearts, tails, livers, blood, bone meal, casings, tankage and the like, it was assumed that these parts were of equal value in the three lots and such differences as are here noted are based on the values of the dressed carcass, hide and fat. This is manifestly inaccurate and tends to exaggerate the differences between the three lots, but is the best that can be done with the data at hand. The consideration of these values for the hides and tallow, however, do not add greatly to accuracy of the computation as these products are certainly worth more per pound to the packer than country prepared products bring in the market, a difference accounted for by the superior condition of the packing house products. Their opportunities are better for marketing and the cost of putting their products into marketable condition is reduced to the minimum. The hides as taken from the animals in the packing houses by experts, under the eyes of still more expert and critical inspectors, are worth very much more per pound than indifferently prepared country hides. As much may be said of the fat; especially such parts of it as are utilized for the manufacture of artificial butter. The values of the three lots to the packers were computed on the basis of the above figures and the results are as follows.

Lot 1 was worth $90.50 per steer; lot 2, $76.31 per steer, and lot 3, $85.02 per steer. The market values of the three lots were, for lot 1, $92.28 per steer, for lot 2, $82.03 per steer, and for lot 3,

$92.38 per steer. It will be seen by this that while on the basis of market values of live cattle on the day they were sold, the packers were obliged to pay ten cents more for each steer in lot 3 than in lot 1, each steer in lot 1 was worth $5.48 more to them than each steer in lot 3. And while each steer in lot 3 cost $10.35 more than in lot 2, the actual value to the packer of each steer in lot 3 aside from offal products other than fat was only $8.71 cents more than in lot 2. This is conclusive evidence that the buyer of the live cattle was practically correct in his estimate of the relative values to the butcher of the steers in lots 2 and 3, but that his judgement was seriously at fault as to the relative values of lots 1 and 3, the former selling on foot at a disadvantage as compared with the latter, while on the hooks, the carcasses of lot 1 were pronounced more valuable by ¼ of a cent per pound than those in lot 3. The error in judgement of the buyer in this instance was in accordance with the universal opinion of good judges as to the relative merits of the various lots of cattle on foot. Not a buyer in the yards would have been willing to pay more per hundred weight for lot 1 than for lot 3. Experienced judges too would have been hard to find, who would have even suspected that the steers in lot 1 would dress a higher percentage of beef and fat than the steers in lot 3. The steers in lot 3 certainly appeared to be more nearly finished when marketed than either of the other lots, but the slaughter test proved that as a matter of fact lot 1 was the more nearly finished.

This but corroborates the statement made by the writer sometime since that the intelligent feeder may know more as to the percentage of beef and fat, and the quality of the beef produced in the cattle he markets than does the buyer who must base his judgement upon the external appearance of the bullock.

So far as the mottling or grain of the beef showed when the carcasses were ribbed, there was no appreciable difference between lots 1 and 3. Lot 3 seemed to be slightly better covered with fat over the rib cut, but the filling of the thighs and covering of same did not seem to be superior to the carcasses in lot 1.

The higher percentage of beef and fat may be accounted for in case of the corn and clover hay lot when we remember that they made greater gains throughout the feeding period than did either of the other lots. This gain must have been either a gain in flesh or a gain in fat, or both. It is evident that it was both as shown by higher percentages of fat and dressed beef and thicker flesh.

At the packing house it was considered that all these lots as bought were worth the money paid. It is seen too, that the packer paid for lot 1, $1.78 per steer more than the dressed beef, hide, and fat were worth and that he paid for lot 2, $5.72 more and for lot 3, $7.36 more per steer than the same parts were worth. Hence, it is seen that lot 3, the steers getting corn, gluten meal, timothy hay, and corn stover was certainly the least profitable of the three to the packer.

Assuming that lot 3 was handled at a profit, it would seem that the packer could have afforded to pay for lot 1, $5.58 and for lot 2, $1.64 more per steer than the price paid. This would have brought lot 1 up to $97.86 and lot 2 up to $83.67 per steer, as the prices which the packer could have paid for these lots and still have handled them at the same profit as lot 3. If lot 3 was bought at a profit at $7.45 per hundred weight, lot 1 should have brought $7.70 and lot 2, $7.13 per hundred weight. These figures show that lots 1 and 2 sold for at least 55 and 20 cents per hundred weight respectively, less than their value because they lacked those superficial evidences of a finished condition which were possessed by lot 3, the gluten meal steers.

These are strong arguements in favor of the use during the finishing period of some oily and nitrogenous food which will produce upon the steer that bloom which sells the animal to advantage.

The Financial Aspect of the Experiment.

It is believed that many feeders will be interested in the following financial statement. The prevailing conditions during the feeding period covered by this experiment were manifestly unusual. Grain and forage could only be had at prices seldom reached by such products. All grades of fat cattle and more especially the choice and prime grades were correspondingly high. Owing largely to prevailing drouth and a prospect for a short corn crop, stock cattle and feeders were in liberal supply during the late summer and early fall and cattle feeders in the corn belt did not buy liberally even though prices for such stock were at times very reasonable. In short, as conditions finally adjusted themselves the opportunity was offered to farmers to buy stockers and feeders at a discount, feed them on high priced grain and roughage, and sell them at a premium when finished at a price which was correspondingly high as compared with the prices for food-stuffs.

In submitting the financial statement of each lot it will be possible to call attention to some important facts connected with cattle feeding by the use of these rations in particular.

Financial Statement.

LOT 1, 13 STEERS.	DR.
To 13 Steers 12528 ℔ @ $4.60 per cwt.	$ 576.29
To 7 Pigs 908 ℔ @ 5.75 per cwt.	52.21
To 3 Pigs 425 ℔ @ 6.50 per cwt.	27.63
To 1 Pig 140 ℔ @ 6.00 per cwt.	8.40
Feed as follows:	
To 235.48 bu. Corn @ 60c	141.29
To 9.51 tons Clover hay @ $11	104.61
To .46 tons Corn meal @ $23.03	10.59
To 8.09 tons Corn and cob meal @ $19.14	154.84
Freight Champaign to Chicago, commission for selling and other expenses	30.00
	$1105.86
Expense of feed in holding last week	23.81
Total expenditures	$1129.67
	CR.
By 1 Steer 1025 ℔—25 ℔ @ $4.60 per cwt.	$ 46.00
By 12 Steers 15170 ℔ @ $7.30 per cwt.	1107.41
By 7 Pigs 1355 ℔ @ $6.50 per cwt.	88.08
By 4 Pigs 660 ℔ @ $7.00 per cwt.	46.20
Total receipts	$1287.69
	1129.61
Profit	$158.02
Average profit per steer	$13.16

LOT 2. 13 STEERS.	DR.
To 13 Steers 12570 ℔ @ $4.60 per cwt.	$578.22
To 7 pigs 903 ℔ @ $5.75 per cwt.	51.92
To 3 pigs 430 ℔ @ $6.50 per cwt.	27.95
To 1 pig 140 ℔ @ $6.00 per cwt.	8.40
Feed as follows:	
To 225.7 bu. corn @ 60c	135.42
To 5.37 tons Timothy hay @ $14.00	75.18
To 7.59 tons Corn and cob meal @ $19.14	145.27
To .41 tons Corn meal @ $23.03	9.44
To 3.17 tons Corn stover @ $6.50	20.61
Freight Champaign to Chicago, commission for selling and other expenses	30.00
	$1082.41
Expense of feed in holding last week	22.03
Total expenditures	$1104.44
	CR.
By 1 Steer 985 ℔ 25 ℔ @ $4.60 per cwt.	$ 44.16
By 12 Steers 14063.04 ℔ @ $7.00 per cwt.	984.41
By 7 Pigs 1300 ℔ @ $6.50 per cwt.	84.50
By 4 Pigs 655 ℔ @ $7.00 per cwt.	45.85
Total receipts	$1158.92
	1104.44
Profit	$54.48
Average profit per steer	$4.45

LOT 3. 13 STEERS.	DR.
To 13 Steers 12662 ℔ @ $4.60 per cwt.	$ 582.45
To 7 Pigs 933 ℔ @ 5.75 per cwt.	53.65
To 3 Pigs 430 ℔ @ 6.50 per cwt.	27.95
To 1 Pig 140 ℔ @ 6.00 per cwt.	8.40
Feed as follows:	
To 138.27 bu. corn @ 60c	82.96
To 5.96 tons timothy hay @ $14.00	83.44
To 6.62 tons corn and cob meal @ $19.14	126.71
To .64 tons corn meal @ $23.03	14.74
To 3.18 tons corn stover @ $6.50	20.67
To 2.09 tons gluten meal @ $28.00	58.52
Freight Champaign to Chicago, commission for selling and other expenses	30.00
	$1089.49
Expense of feed in holding last week	22.47
Total expenditures	$1111.96
	CR.
By 1 Steer 985 ℔ – 25 ℔ @ $4.60	$ 44.16
By 12 Steers 14880 ℔ @ $7.45	1108.56
By 7 Pigs 1295 ℔ @ $6.50	84.18
By 4 Pigs 630 ℔ @ $7.00	44.10
Total receipts	$1281.00
	1111.96
Profit	$169.04
Average profit per steer	$14.08

After the "filling up" process, lasting some weeks and taking into account all expenses such as freight, commission and feed, it is found that the steers cost in the feed lots, February 8th, practically $4.60 per hundred weight, or just what they cost us in Chicago; hence, the purchase price is figured on the basis of their weights at the beginning of the experiment proper and at $4.60 per hundred weight.

No charge is made in the financial statement for labor in caring for the steers, nor on the other hand is any value assigned to the manure made by the steers. It is believed that the manure would more than balance the cost of labor involved.

The cattle were not full fed during the season best calculated to secure the greatest or most economical gains. They were not purchased when stockers and feeders were cheapest. The same grade of feeders could have been bought earlier in the season for at least $1.00 per hundred weight less. Hay and other roughage was bought in the bale, hence more expensive than it would otherwise have been. That one of the steers proving an unprofitable feeder made the sale at a low price of two other steers necessary simply multiplies by three the loss which would have been sustained under ordinary feed lot conditions.

These facts are enumerated not in the way of an apology for existing conditions, but rather that the reader may not misinterpret certain items appearing in the financial statement. By referring to the statement it will be seen that under current market conditions slightly the greatest profit was secured with lot 3, the one getting corn, gluten meal, timothy hay, and corn stover; the next greatest profit being secured with lot 1, the lot getting corn and clover hay. This difference is so slight that a repetition of the same experiment even under like market conditions for foodstuffs and fat cattle might show an advantage in favor of the lot receiving a ration of corn and clover hay. Again it should be said that any condition which would change the relative prices for gluten meal, corn, timothy hay and clover hay prevailing during the experiment would give the advantage to the one or the other ration. It is but fair to the corn and clover hay ration to state that the prevailing price for gluten meal during this experiment was much closer to the price of corn than is usually the case, and that the price at which clover hay is figured, (clover hay being the chief source of nitrogen in the ration for lot 1) is higher accordingly than the price at which gluten meal is figured. It is altogether probable therefore, that from the financial standpoint alone the use of a ration of corn and clover hay would prove more profitable to the feeder than a ration of corn, gluten meal, timothy hay, and corn stover fed in the proportions used in this experiment particularly because clover hay can be grown on the farm. The farmer would be obliged to pay the same for gluten meal that was paid in the experiment, but would not have to pay the same for clover hay.

The financial statement but emphasizes the importance on the one hand of securing a finish on the steers that is demanded in the market, since twelve steers weighing but 14880 pounds sold on the same day in the Chicago market within $1.15 as much as another twelve steers weighing 290 pounds more. On the other hand notwithstanding the fact that twelve steers sold for fifteen cents per hundred weight more than another twelve steers the latter returned to the feeder practically as great a profit, largely because they made greater and more rapid gains on less expensive foodstuffs.

The ideal ration should combine the good features of both the rations fed to lots 1 and 3.

For purposes of reference in connection with weights of individuals, their gains and the character of the dressed carcasses, notes were taken on each of these animals at the beginning of the experiment, at the termination of the fattening and after the slaughter.

On March 8th and June 21st the following notes on individual steers were taken by E. B. Forbes, an assistant in the department.

In the preliminary notes taken on March 8th, only such characteristics were noted as were thought to have some connection, either direct or remote, with the capacity of the steer as a beef producer.

TABLE 5.

INDIVIDUAL WEIGHTS OF STEERS.

No. of steer.	Average weight, Mar. 20, 21, 22.	Average weight June 12 and 14.	Gain during twelve weeks.	Average daily gain.	Dressed weight.
1	1041.66	1252.5	210.84	2.51	734
2	1030.	1207.5	177.5	2.11	732
3	1020.	1262.5	242.5	2.89	752
4	1136.66	1317.5	180.84	2.15	767
5	998.66	1147.5	148.84	1.77	702
6	1115.	1340.	225.	2.68	790
7	1180.	1372.5	192.5	2.29	815
9	1153.33	1402.5	249.17	2.97	829
10	1180.	1362.5	182.5	2.17	808
11	1105.	1217.5	112.5	1.34	705
12	1155.	1357.5	202.5	2.41	814
13	973.33	1212.5	239.17	2.85	670
14	1046.66	1260.	212.34	2.53	695
16	1073.33	1232.5	159.17	1.89	710
17	1016.66	1157.5	140.84	1.68	693
18	1100.	1302.5	202.5	2.41	744
19	988.33	1187.5	189.17	2.25	665
20	1095.	1237.5	142.5	1.70	720
21	1056.66	1227.5	170.84	2.03	...
22	896.66	1045.	148.34	1.77	556
23	1052.	1220.	168.	2.00	694
24	1055.	1205.	150.	1.79	680
25	1041.66	1150.	138.34	1.65	678
26	1066.66	1235.	168.34	2.00	692
28	1155.	1345.	190.	2.26	810
29	1136.66	1335.	198.34	2.36	761
30	1073.33	1247.5	174.17	2.07	740
31	1100.	1332.5	232.5	2.77	762
32	1126.66	1337.5	210.84	2.51	780
33	1058.33	1275.	216.67	2.58	710
34	991.66	1167.5	175.84	2.09	653
35	986.66	1225.	238.34	2.84	717
36	1043.33	1232.5	189.17	2.25	696
37	996.66	1210.	213.34	2.54	680
38	980.	1177.5	197.5	2.35	692
39	1175.	1347.5	172.5	2.05	765

The notes taken after the close of the experiment on June 21st, considered the condition of the animal as regards fatness, the style and the degree of the finish attained.

After the animals were slaughtered in Chicago the carcasses were judged by Mr. J. E. Maurer, of the Schwarzschild & Sulzberger Co., and Mr. John Irwin of Chicago. Their comments with some slight additions constitute the notes on carcasses.

The following are the individual notes with numbers to correspond to those of the animals:

1. March 8th. Red Shorthorn. This animal is light; lacks breadth and depth, and is coarse-boned throughout. Face, long; eye, dull. Crops, high and thin; loin, low; tail-head, high; lacks capacity and depth of flanks; chest, narrow; shoulder-points, rough; quarters, a little light; skin, soft and of medium thickness; coat, thin.

June 21st. Shoulders, bare; crops, not filled; back, bare; hip-bones and tail-head, bare; thin in thighs; far from fat.

2. March 8th. Red Shorthorn with touch of Jersey blood. This steer is thin-fleshed, narrow and rough-boned, but is fairly deep. Face, long, marked with black streaks; muzzle, black; neck, short; shoulders, high; back, low; ribs, flat; crops and quarters, light; hips, rough; coat not thick nor especially fine; skin, loose, elastic, and of medium thickness; the Jersey back is the poorest feature of this steer and its depth of body is its best character.

June 21st. Shoulders, smooth; crops, nearly full; back, smooth; hips, nearly covered; rump, not well fleshed; cod, beginning to fill.

June 25th. Carcass. A profitable cutting bullock; very evenly and smoothly fatted with fairly thick rib and loin.

3. March 8th. Red Shorthorn. Depth of body, good; breadth, average; head, rather small; neck, short; fore flank of average development; chest of average width; paunch, capacious; hind flank, fairly low; thighs and twist, deep; back and crops. smooth; rump, rough.

June 21st. Shoulders, crops, back and loin thickly covered: animal not very fat; thighs, strong; buttock would finish up deep and full.

June 25th. Carcass. Good medium bullock; has taken on seam-fat well; begins to be lumpy.

4. March 8th. Shorthorn; very light yellowish-red, shows Jersey blood; breadth, average; depth, good; head, thick and heavy with dull eyes; muzzle, white and surrounded with dun and black hair; chest, rather wide; top-line, a little high at shoulder and low at crops; hip bones, a little high and prominent; fore flank, full; skin, hard.

June 21st. Shoulders, rough; crops, not full; back, not covered; hip-bones, prominent; rump, not fleshed.

June 25th. Carcass. An old steer, not at all well covered; sunken in loin; shows age in flinty character of bones.

5. March 8th. Red Shorthorn; a fine, smooth, nicely shaped animal of fairly good conformation and quality, but too light; has good lines and will make a trim carcass; head shows breeding; eyes, bright; ears, small, neat; hide of medium thickness, elastic; a nice handler; lacks depth and capacity of paunch.

June 21st. Shoulders fairly well covered; crops, smooth; hip-bones and rump a little bare; thighs, light below.

June 25th. Carcass. A chunky bullock with very little waste; proportion of plate and chuck is small.

6. March 8th. Roan Shorthorn; an upstanding animal; depth fair; breadth, deficient, has plenty of scale; bone, strong and a little rough; head and ears, large; forehead, broad; face, narrow; muzzle, broad; tail-head, high; chest, a little narrow; ribs, flat; paunch, capacious; hide, thin and hard.

June 21st. Shoulders, bare; crops not full; back not covered; hip-bones very prominent; rump, bare; cod only beginning to fill; a coarse growthy steer.

June 25th. Carcass. A plain bullock; not heavily covered; has a little too much belly.

7. March 8th. Red Shorthorn with possible touch of Hereford blood, narrow and deep in front; broad and high behind; shoulder, high; back low; middle of rump, high; hip-bones a little high; brisket, heavy; fore flank, deficient; paunch, heavy; hide thick.

June 21st. Shoulder, crops and back half-covered; hip-hones and tail-head still a little rough; thighs, heavy, but not very deep; cod, half filled.

June 25th. Carcass. A good bullock; a good cutter; fat well distributed; good rib and loin; not wasty.

9. March 8th. White Shorthorn, good feeder, but lacks quality; head, broad, coarse; eyes, mild, clear, small; neck, a trifle too long; chest, full; back, broad, level; hips, smooth; point of shoulder, rough and prominent; top of shoulder, compact; tail-head, a little high; body, deep; paunch, capacious; flank and twist, too much cut up; skin, somewhat hard, medium thickness; bone, coarse.

June 21st. Shoulders not smooth; ribs still show; crops and back not fully covered; hip bones nearly smooth; buttock, heavy; cod only begins to fill; a growthy, muscular bullock, but not yet ripe.

June 25th. Carcass. A good bullock; could have been made choice; carcass well proportioned and evenly covered.

10. March 8th. Red Shorthorn; light and narrow, but smooth except for rough shoulder; attractive head, but face too long; neck, long; fore and hind flanks, light; chest narrow; heart-girth deficient; body deep; paunch, capacious; bone, fine; skin, thin; coat, very fine.

June 21st. Crops and back smooth, but not fat; hip-bones, too prominent; rump tapers off behind; buttock, meaty; cod, half filled.

June 25th. Carcass. Not the best color; a good medium steer, but thin and lengthy in rib and loin; is a trifle staggy.

11. March 8th. Red; good depth; good top-line, but high in flanks and twist; head, small, with Roman nose; dun hair and dark spots about muzzle; has a projecting lower jaw; eyes, close together; fore ribs, flat; paunch, capacious; skin, medium thick, not very elastic; coat, crisp like that of a buffalo.

June 21st. Shoulders, crops and back just beginning to cover; ribs and hip-bones not well covered; thighs, full and deep.

June 25th. Carcass. A very desirable carcass; short, thick, not wasty; color good; carries just a little too much belly.

12. March 8th. Shorthorn with some Hereford markings; will be a big steer; heavy and deep in front; breadth only average; head, fine; neck, long; back and crops, smooth; tail-head, smooth and low but rump high in middle; quarters, fairly deep and full, but legs long; gaskins, very long; hocks, very crooked; paunch, adequate; skin, thin; coat, short, soft, mossy, deep red.

June 21st. Shoulders, crops and back half fat; hip-bones and tail-head still prominent; buttock heavily fleshed; animal looks thick fleshed, but rough.

June 25th. Carcass. A bit rangy; carcass fairly well covered; fat enough for handy block beef.

13. March 8th. Red Shorthorn with Hereford markings on forehead, withers, feet and underline; average depth, breadth and smoothness; face, long; eyes, clear; ears, fine; neck, a trifle long; crops, deficient; back, narrow; tail-head, high; chest, neither very full nor deep; belly, paunchy; flank and quarters, medium development; hide, hard, thin; coat, short, thick, fine and mossy

June 21st. Shoulders, crops and back have no covering of fat; tail-head, high; buttock, fairly well filled; cod, not at all filled.

June 25th. Carcass. Steer has big belly and very thin rib and loin.

14. March 8th. Spotted Shorthorn; deep and compact with short neck, but narrow in face, shoulders, back and loin; fore-ribs, fairly well sprung; top-line, good except for high tail-head; under-line, fair, high behind; bone, rather smooth and fine; hide of average thickness and elasticity.

June 21st. Shoulders bare; crops, half filled; back, hip-bones and buttock smooth and half fat; a very trim animal.

June 25th. Carcass. Has big belly; not evenly covered on rib and round, especially the latter.

16. March 8th. Red Shorthorn; face and rump streaked with black; the thin-fleshed sort; lacks depth and breadth; neck, long; light thighs and flank; tail-head, high; heart-girth, deficient; paunch, average size; hide, thick.

June 21st. Shoulders bare; crops, full; back and loin not fat; rump fairly fleshy, but bones prominent; cod, only begins to fill.

June 25th. Carcass. Good rib and loin, but not very fat; not as well covered as some others.

17. March 8th. Dark-red Shorthorn; good top and under-lines; a little narrow, but has full floor of chest; head, narrow; neck, long; heart-girth, very good; bone, hair and hide of good quality.

June 21st. Shoulders and crops not fat; back, rump, and buttock smooth, but light; cod begins to fill; a fine butcher's steer; too fine for a good feeder.

June 25th. Carcass. Evenly fat; chunky; well shaped; a good seller; well covered, fairly thick chine and fair sized kidney.

18. March 8th. Light-red Shorthorn; deep, but a little narrow, light and upstanding; good top-line and under-line; chest broad and deep; heart-girth and capacity of body above avarage; quality of bone, hair and hide, all that could be desired.

June 21st. Shoulders and crops half fat; back begins to flesh up; hip-bones and rump lightly fleshed, but covering up.

June 25th. Carcass. A good meaty bullock; compact in rib and loin; even, symmetrical and well covered.

19. March 8th. Red Shorthorn with possible Hereford admixture; neck, long, thin; shoulders, prominent, high; crops and loin, low and narrow; tail-head, hip-bones, high; chest, narrow; body, fairly deep; paunch, average size; flank, high; hocks, crooked; hide, thin, not elastic; coat, soft and kinky; a thin-fleshed animal.

June 21st. Shoulders, crops and back bare; hip-bones prominent; thighs, light; twist, badly cut up.

June 25th. Carcass. Lacks thickness of rib and loin; is better than No. 14, but not so good as No. 17.

20. March 8th. Roan Shorthorn; a coarse growthy, big-boned fellow, good depth; average breadth; a little narrow at shoulders and crops; tail-head high, but hips smooth; brisket, heavy; skin elastic; hair, very fine and soft.

June 21st. Shoulders, crops and back heavily covered; hip-bones prominent; rump, rough; thighs, heavy; a rough, growthy animal.

June 25th. Carcass. Evenly covered with fat; lacks thickness of flesh.

21. March 8th. Light-red Shorthorn; breadth, average; depth, deficient; head, neat, fine, with high poll and lump on jaw; neck, long; back, low; flank, high; twist, light; skin thin, not elastic; hair, fine.

June 21st. The light sort; long legs; high behind; does not begin to be fat.

June 25th. Steer held by State Board of Health because of suspected lumpy-jaw.

22. March 8th. Dark-red Shorthorn; a little light, fine steer; body narrow and lacking in depth; good top-line; head, very neat and trim; neck, short; back-bone, high at crops; fore ribs, flat; barrel, not well ribbed up to hip bones; thin-fleshed; thighs, light; lacks paunch; looks stunted.

June 21st. Very thin and light in flesh; all bones show; back-bone high and sharp; ribs show plainly; no flesh in twist; has done poorly.

June 25th. Carcass. A very poor bullock; is much like No. 14; has much plate and is very deficient in thickness of rib and loin; is the least desirable carcass in the lot.

23. March 8th. Roan Shorthorn; average breadth; depth, a little deficient; ribs, fairly well sprung; head, large, plain; face prominent; hips, rough; rump, steep; tail-head, high; rather good thighs; paunch, capacious, bone and hair, coarse.

June 21st. Growthy; half covered all over; would in time flesh up into a good carcass; is fleshing up evenly, but is only half fat.

June 25th. Carcass. Short, chunky; fairly well covered in rib and loin; is shorter and heavier than No. 24.

24. March 8. Dark-red Shorthorn; long, deep and rather low set; head, neat, broad; forehead, square with heavy mat of hair; neck, trim, medium length; back-bone, high at crops, low at back, narrow at loin; fore ribs, flat; heart-girth, slightly deficient; skin, thick and not elastic.

June 21st. Shoulders, crops and back not heavily fleshed; hip-bones covering up; rump not quite covered, but would finish smooth; buttock heavy, but not very deep and not fat; cod not filled.

June 25th. Carcass. A meaty, evenly fatted bullock, but has no fat on inside of ribs as in Nos. 19 and 25.

25. March 8th. Dark-red Shorthorn with one horn; a light, thin fellow, lacking depth and breadth; face, neck and legs, long; hip-bones, high; rump, peaked; buttock, narrow; heart-girth, deficient; paunch, deficient; flank high.

June 21st. Thin fleshed all over; does not begin to be fat; has done very poorly; very light and high in twist; all bones show.

June 25th. Carcass. Much like No. 19; has a little heavier kidney, but is very thin in rib and loin.

26. March 8th. Roan Shorthorn; upstanding, growthy, smooth-boned, narrow at shoulders and crops; face, a bit long; jaw, not deep; rump, peaked; flank and twist, high; depth of chest, good; heart-girth, fair; paunch, capacious; skin, thin, not elastic; coat silky; bone, strong.

June 21st. Shoulders and crops not smooth; hips nearly smooth; thighs heavy, but twist high; cod half filled.

June 25th. Carcass. Fairly thick rib and loin; is well covered, but not as good in quality as some others.

28. March 8th. Roan Shorthorn; good breadth throughout; has excellent colors and shows good breeding; head, just a bit rough; chest and shoulders very broad; shoulders, a little rough; brisket, very broad, trim and smooth; crops, a little slack; back, smooth and of good breadth; paunch, capacious; rump does not carry width to tail-head; thighs, thick and meaty; twist, full, but not especially low; bone, medium; coat and hide constitute this steer an elegant handler.

June 21st. Shoulders not yet smooth; crops, nearly full; back thickly covered; inclines to wrinkles; hips nearly covered; buttock, fleshy; a broad, thick-fleshed, paunchy steer.

June 25th. Carcass. A good profitable carcass; heavy rib and loin; characterized by thickness of flesh and tendency to be lumpy; not as good as No. 29.

29. March 8th. Red Shorthorn; a narrow strong-boned, flat-ribbed steer; head, broad with Roman nose; withers and crops, high; rump, sloping; thighs, full; paunch, capacious; barrel, not closely ribbed up to hip-bones; hind flank rather low.

June 21st. Shoulders and crops half fat; back is taking on flesh, but hip-bones are prominent; thighs, heavy; twist, deep, a paunchy steer.

June 25th. Carcass. A very desirable carcass; very thick rib and loin; a choice bullock.

30. March 8th. Dark-roan Shorthorn; a leggy steer, lacking in breadth throughout and depth behind; has plenty of depth through brisket, but lacks paunch and development of hind parts though he has good crops and back; bone, coarse; hide hard.

June 21st. Deep in front; bare shoulders, crops, back and hip-bones; light behind; cod only begins to fill.

June 25th. Carcass. A rough, undesirable steer; is gobby and not well covered.

31. March 8th. Red Shorthorn with white spots; a very deep steer in proportion to length; low-set, narrow and flat-ribbed; head, long, narrow; ears small; back and rump, narrow; paunch very large; bone and hide medium; coat, fine.

June 21st. Shoulders nearly smooth; crops, nearly full; back and rump rather bare though smooth; buttock, fat; twist, well filled; cod, nearly full.

June 25th. Carcass. Ideal shape; fine color; a good handy bullock, but has a little too much plate.

32. March 8th. Light-red with white spots, shows Jersey blood; broad; average depth; head, heavy; back straight; tail-head, high; not square behind; cuts in below buttock; hips, rough; breadth of chest, heart-girth, fairly good; has plenty of capacity and is thick-fleshed.

June 21st. Shoulders rough; crops and back are covering up smoothly, but are not thickly covered; twist, high; cod begins to fill.

June 25th. Carcass. Steer is heavy in chuck and looks staggy; is light in round and not good in color.

33. March 8th. Dark-roan Shorthorn; deep, but narrow in front though floor of chest is fairly wide; broad, but high and light behind; not closely ribbed up to hip-bones; crops, fair; paunch, capacious; heart-girth, good.

June 21st. Shoulders nearly smooth; crops, full; back, smooth; hips, nearly covered; loin not covered; twist not full.

June 25th. Carcass. Just a medium bullock; loin not thick.

34. March 8th. Red and white Shorthorn; lacks depth and breadth; is light-smooth, thin-fleshed and leggy; head, hair, hide and bone medium to fine; back bone, high and sharp, high in middle of rump; chest and paunch lack depth.

June 21st. Has taken on some flesh, but is thin all over; back bare; twist not filled.

June 25th. Carcass. Just a medium steer with no particularly bad points; not heavily covered in rib and loin.

35. March 8th. Reddish-yellow and white animal with Jersey appearance; narrow, lacks depth; the thin-fleshed sort; medium sized head; puffy, watery eyes; much dewlap; crops slack; fore ribs, flat; high dairy hook-points; average heart-girth and paunch.

June 21st. Shoulders prominent; crops begin to be full; back and loin getting pretty well covered; hip-bones very prominent; twist, high.

June 25th. Carcass. Just an average steer.

36. March 8th. Red Shorthorn; high, narrow, gaunt, light, coarse-boned; hind pasterns knuckle over badly; head, fair; fore ribs, flat; paunch lacks capacity; flank, high; thighs and twist light and high; skin, fine.

June 21st. Shoulders, rough; crops, loin, hips and rump bare; twist not at all filled out.

June 25th. Carcass. An undesirable carcass; did not fatten very well; has not much loin; is a "mean" one, on the "rain-back" order.

37. March 8th. White Shorthorn; average depth; lacks breadth of back, light behind; head and legs, coarse; good top-line; chest of average breadth; has plenty of paunch; coat, coarse; skin, pliable.

June 21st. Crops filling up; back loin and hips pretty well covered; twist not filled.

June 25th. Carcass. A tidy, evenly covered, good cutting buttock.

38. March 8th. Dark-red Shorthorn: a light steer, but rather well formed; just average depth and breadth and length of leg; head, refined; ears, small, fine; nose, prominent; rump, tapers; flank, low; quarters, deep; bone, fine enough; paunch and heart-girth of average development.

June 21st. Is smoothing up nicely all over, but is not yet thickly covered with fat.

June 25th. Carcass. A good loin, but would get gobby; is a little on the rough order.

39. March 8th. Light-red Shorthorn; depth and breadth, average; head, large, but well proportioned, rather smooth; top-line straight, but tail-head and hips a little high; chest and heart-girth just fair; legs, medium long; paunch, fairly capacious; coat and skin, fine and soft; bone medium.

June 21st. Shoulder would cover smoothly, but animal is only half fat; crops and back, smooth, but not thickly covered; loin, bare of fat; twist, high.

June 25th. Carcass. This is a rangy steer; is long and light; never would be good; is gobby; has big belly and long shanks.

Throughout the experiment the good spirits of lot 1, the sluggish disposition of lot 2 and the capricious appetite of lot 3 were noticeable.

By consulting Table 5 it is seen that No. 11, reported as being off feed four times made the poorest gain in lot 1. Turning to the notes on individuals we see that the steer had a capacious paunch, but was an ill-shaped animal, slack in the heart-girth, and with evidences of poor breeding. It is worth while to note in this connection that a capacious paunch without other evidences of beef form is of little consequence as indicating a capacity for beef production.

No. 24, reported as off feed eight times was one of the poorer producers in lot 2, but several which did not gain quite so well were not reported as off feed. This steer evidenced his poor character by being high in the crops, low in the back, deficient in heart-girth, flat in fore ribs and lacking in elasticity of hide.

No. 34, reported as off feed six times was one of the poorest producers in lot 2 though two others made slightly smaller gains per day. This steer lacks depth and breadth and capacity of paunch.

No. 37, reported as off feed seven times made gains somewhat above the average in lot 3. There is nothing especial in the notes on this steer's conformation to show that he might be expected to be a poor feeder.

A study of these individual notes serves to emphasize a few points of importance to feeders of fattening cattle.

The animal most desirable from the butcher's standpoint is not necessarily the most desirable from the feeder's point of view. It may be too fine to be hearty and vigorous, and may not have that capacity of barrel which is requisite to either large or economical gains in live weight. Indeed, the butcher desires a type of animal of more restricted capacity than that one in which the beef producer finds greatest profit in feeding and his best interest is also favored by the animal of most refined bone and extremities.

This refinement may be accompanied by a delicacy of habit which renders the animal an unprofitable feeder. In fact, among animals which are not highly improved by careful selection the fine individual is very apt indeed to be the delicate one. Among such unimproved animals the somewhat coarse, growthy individual with unimpaired vigor, strong bone and a capacious paunch is the more profitable type to fatten. A profitable feeding steer conforming to these requirements is, of course, an old one. This means that some one grew him either at very low cost or at very little profit. While it would be absurd to consider growing such steers from calfhood to maturity on Illinois land there are circumstances under which it seems profitable to fatten such steers in Illinois, the one great point in their favor being their capacity to make large gains in a given time. There can be no doubt but that this type of animal, especially if well grown before fattening begins. will make larger gains in live weight in a given time than finer and younger animals of the same breeding.

Whether or not these gains are produced as economically as in the case of the more refined type of animal is a question, but it seems entirely probable that the matter of economy of production is more closely connected with breadth of chest and capacity of paunch than with coarseness or refinement of bone and extremities.

It should be borne in mind that capacity in an animal to make large gains in live weight in a given time may under certain conditions be of greater importance to the producer than the highest degree of capacity in the animal to make economical gains, though, of course highly improved beef animals posessing both these characteristics to a marked degree are in general much the most profitable to all concerned in their production, handling, and consumption.

In this experiment as the animals were fed in lots of twelve there was no way of determining which were or were not economical producers, but the individual weights do show which of the animals were the largest producers.

While the system of study and record of the characters of these steers was very crude, the notes do show in a general way that the large producers were the conspicuously paunchy steers, and that the poorest producers were those steers which were lacking in capacity of the barrel.

It seems altogether likely, however, that there is in the fattening beef animal a marked individuality in respect to the economy and perfection of its physiological activities, aside from that which is indicated by easily discernable external characteristics.

After the slaughter test it was said by Mr. J. E. Maurer of the Schwarzchild & Sulzberger Co., that lots 1 and 3 were as fat as it is desirable to have beef of this quality. Lot 2 was decidedly lacking in fat.

The steers as a lot were criticized as being paunchy. This seems to have been due more to the method of rearing than to the method of fattening these animals.

As to the covering of the carcasses with fat, lot 3 was a little more completely and thickly covered than lot 1, the difference being noticeable on the ribs; but this difference appeared very slight, not nearly so pronounced as would have been supposed from the appearance of the two lots on foot. Lot 2 was not so completely or thickly covered with fat as lots 1 and 3.

The flesh in lot 1 proved to be thicker than in lot 3 and much thicker than in lot 2. The kidney fat in lot 1 was also heavier than in lots 2 and 3.

The color of the carcasses in the three lots was with the exexception of one steer invariably excellent. The color of lot 3 was very slightly superior to that of lots 1 and 2.

In value per pound lot 1 was rated at 10¾ cents, lot 2 at 10 cents, and lot 3 at 10½ cents. Lot 1 was rated above lot 3 because the carcasses in this lot were heavier and were thicker fleshed, this in spite of the fact that the price paid for lot 3 was decidedly greater than that paid for lot 1. As the prices at this time were much higher for heavy weight cattle than for lighter stuff, lot 1, the heaviest lot, was on this account alone more valuable per pound than lots 2 and 3. It should be borne in mind that this advantage in weight of lot 1 over lots 2 and 3 was attained during the fattening period.

The desirable carcasses in each lot were the thick-fleshed ones, some of those acquired this thickness of flesh during the fattening period, notably those in lot 1; some were comparatively thick-fleshed at the start.

Both the desirable and undesirable characteristics of the carcasses were quite generally noticeable even to a comparatively untrained eye not only in the dressed beef and in the fatted animal on foot, but even in the thin steer at the beginning of the fattening period. Fortunately for the beef producer the characteristics which a steer must possess in order to make a carcass which will be satisfactory to the butcher and the consumer are neither far to seek nor difficult to recognize.

By referring to Table 5 it will be seen that only two steers in lot 1 failed to make an average daily gain of two pounds; in lot 2 six steers fell short of the two-pound per day record, while in lot 3 every steer made gains of two pounds per steer per day or better.

CONCLUSIONS.

1. This experiment indicates that corn may be supplemented with clover hay, a nitrogenous roughage, in such a way that its influence will be practically as beneficial as the supplementing of corn with a nitrogenous concentrate such as gluten meal.

2. That where clover hay, or some other nitrogenous roughage is not available for supplementing the corn crop in fattening steers a nitrogenous concentrate like gluten meal is highly advantageous.

3. That neither the corn ration supplemented by the use of a nitrogenous roughage on the one hand nor of a nitrogenous concentrate on the other proved to be an ideal ration. It is believed that some judicious combination of the two yet to be determined will be found more satisfactory and profitable than either.

4. A ration of corn, timothy hay, and corn stover has little to recommend it for beef production. It is not favorable for the production of large, rapid, or economical gains; nor is the beef produced by the use of such a ration desirable. It required 1.5 pounds more grain and .7 pounds more roughage to produce each pound of gain where timothy hay supplemented corn than where clover hay was used.

5. The corn and clover hay ration possessed the following

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advantages: (a) Available on Illinois farms; (b) Produced large gains; (c) Considered either from the standpoint of total beef produced or the cost of such beef it was a large and economical producer; (d) The beneficial effects of the clover hay in the ration of lot 1 appeared to extend to the pigs as not only were greater gains in live weight of pigs made in lot 1 than in the other lots, but also more economical gains.

6. This experiment emphasizes the importance of the roughage part of the ration for fattening steers.

7. The slaughter test of this experiment showed that the corn and timothy hay ration had a tendency to produce a high percentage of internal fat without securing a relatively high percentage of dressed beef, thickness of flesh or covering of surface fat; all of which are very important from the standpoint of a profitable animal for the butcher, and hence its value on the open market.

8. It is impossible to determine whether the corn and clover hay ration or the corn, gluten meal, timothy hay, and corn stover ration had the greater tendency to produce lean beef, or flesh as greater gain of the steers fed corn and clover hay would naturally be followed by thicker flesh provided their lean beef making tendencies were the same. It is evident, however, that both the corn and clover hay ration and the corn, gluten meal, timothy hay, and corn stover ration had an advantage over the corn, timothy hay, and corn stover ration in this respect.

9. It appears that the ration, where gluten meal is the conspicuous nitrogenous factor, has the ability to produce the finish demanded by the market with the least expenditure of both quantity and cost of food-stuffs of any ration used in this experiment. The fact that there was more profit to the producer in the use of the ration containing gluten meal, notwithstanding the somewhat expensive nitrogenous concentrate used, is due to the combined facts of its being an equally effective ration as corn and clover hay to the securing of better finish without the necessity of putting on the maximum amount of unprofitable gains in live weight, and to the current prices of corn, gluten meal, and clover hay.

10. The value of the manure made by the steers in lot 1 would be much more valuable per ton than that made by either of the other lots.

11. The condition of the feed lots is an important factor both in the extent and economy of gains.

12. In practice the feeder must determine for himself the best ration for fattening steers by knowing the effectiveness of various rations and their availableness.